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# Journal of the Society of Arts.

FRIDAY, FEBRUARY 26, 1869.

## Announcements by the Council.

### ORDINARY MEETINGS.

MONDAY MORNING, 1ST MARCH.—Adjourned discussion on Mr. HENRY COLE's paper, "On the Efficiency and Economy of a National Army, in connection with the Industry and Education of the People." A. J. MUNDELLA, Esq., M.P., will take the chair at 11 a.m.

Wednesday Evenings at eight o'clock :—

MARCH 3.—"On the Adaptation and Extension of Present Means for the Promotion of Scientific Instruction." By H. H. SALES, Esq. On this evening Lord FREDERICK CAVENDISH, M.P., will preside.

MARCH 10.—"On the Screw Propeller." By N. P. BURGH, Esq., C.E.

MARCH 17.—"On the Trade and Commerce of Japan." By WILLIAM DAVISON, Esq.

MARCH 24.—*Passion Week*.—No MEETING.

MARCH 31.—"On Technical Education, considered in relation to Female Schools." By ELLIS A. DAVIDSON, Esq., Lecturer on Science and Art in the City of London Middle Class Schools.

APRIL 7.—"On the Theory of Boiling in connection with some processes in the Useful Arts." By CHARLES TOMLINSON, Esq., F.R.S., F.C.S.

### FINAL EXAMINATIONS, 1869.

In order to avoid holding these Examinations on the same evenings as those of the Department of Science and Art, it has been decided to hold them, in 1869, on the evenings of

**TUESDAY, the 20th APRIL,**  
**WEDNESDAY, the 21st    ,,**  
**THURSDAY, the 22nd    ,,**  
**FRIDAY, the 23rd     ,,**

From 7 p.m. to 10 p.m., instead of on the 27th, 28th, 29th, and 30th April, as announced in the Programme of Examinations for 1869.

In consequence of this alteration the Previous Examinations must be held earlier, and the Forms No. 2 and No. 4, referred to in par. 6 of the Programme, must of course be sent in a week earlier than the dates there fixed for receiving them.

A copy of Form No. 2 has been forwarded to each Local Board, and should be filled up and returned to the Secretary of the Society of Arts by the 11th March.

In reference to the subjects referred to in the notice at page 9 of the Programme, a sufficient number of applications from candidates in Conic Sections, Navigation and Nautical Astronomy, and Mining and Metallurgy, have already been received. Papers will therefore be set in these subjects.

No paper will be set in Italian.

Local Boards having candidates either in the "Theory of Music" or in "Elementary Musical Composition (Tonic Sol-fa System)," should communicate with the Secretary of the Society of Arts without delay.

### FREE LIBRARIES AND MUSEUMS.

The Council have appointed a Committee to consider and report how the Society may aid in promoting the establishment of Free Libraries and Museums of Science and Art throughout the United Kingdom.

The following gentlemen have been invited to serve on the Committee :—

T. D. Acland, M.P.	Lord Henry G. Lennox,
*Antonio Brady, Member of the Council.	M.P., Chairman of the Council.
Professor Brayley.	Sir John Pakington, Bart., M.P.
The Lord Chancellor, Vice-Pres. of the Society.	Charles Reed, M.P.
*Hyde Clarke, Member of the Council.	*Samuel Redgrave, Vice-Pres. of the Society.
*Henry Cole, C.B., Vice-Pres. of the Society.	*Seymour Teulon, Member of the Council.
*Sir Daniel Cooper, Bart., Member of the Council.	*James T. Ware, Member of the Council.
*Chas. Wentworth Dilke, M.P.	*General Eardley Wilmot, R.A.
Hepworth Dixon.	*The Archbishop of York, Vice-President of the Society.
*Captain Donnelly, R.E.	
Captain Festing, R.E.	
*George Godwin, F.R.S.	

\* Those gentlemen whose names have an asterisk (\*) have already consented to serve on the Committee.

### INSTITUTIONS.

The following Institutions have been received into Union since the last announcement :—  
 Milford (Derby) Evening Schools.  
 Stockport, Sunday School Improvement Society.

### SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

## Proceedings of the Society.

### COMMITTEE ON INDIA.

This Committee met on Tuesday, the 16th February, at four o'clock. Present :—Major-General Sir Vincent Eyre, K.C.S.I., in the chair, Sir Daniel Cooper, Bart., Major-General Sir Wm. Denison, Dr. Archibald Campbell, Messrs. Hyde Clarke, and C. H. Fielder.

The Committee resolved to recommend to the Council the following list of gentlemen interested in Indian matters who should be invited to join the Committee :—

Col. Anderson.  
Geo. Appleton.  
H. G. Bainbridge.  
\*General Balfour.  
P. Battiscombe.  
Thos. Bazley, M.P.  
Sir C. Beadon.  
Dr. Alexander Beattie.  
\*Samuel Brown.  
J. A. Burkinyoung.  
Major-Gen. Felham Burn.  
E. C. Buxton.  
\*G. Campbell.  
Col. Sir Proby Cautley,  
F.R.S.  
H. C. Cavendish.  
David Chadwick, M.P.  
Edwin Chadwick, C.B.  
John Cheetham.  
Major-General Clarke.  
Col. Collyer, R.E., A.I.C.E.  
Gen. Sir A. Cotton.  
Juland Danvers.  
C. A. Day.  
C. W. Dilke, M.P.  
James Fergusson, F.R.S.  
Sir Bartle Frere.  
W. Gilbert.  
Perrie Gordon.  
Arthur Grote.  
Arthur Hall.  
R. P. Harrison.  
Smith Harrison.  
Lord William Hay.  
F. Heathcote.  
Wm. Henderson.  
\*F. Hendriks.  
Richard Hoare.  
B. H. Hodgson.  
Dr. John Jackson.  
Julius Jeffreys.  
C. Jellicoe.  
H. M. Kemshead.  
Col. N. Lees.  
Thos. Login.

D. Mackinlay.  
Sir Ranald Martin, C.B.,  
M.D., F.R.S.  
C. McGarel.  
J. O. Milledge.  
E. Miller.  
S. B. Miller.  
\*Sir Robert Montgomery,  
K.C.B., G.C.S.I.  
Dyce Nichol, M.P.  
W. D. Oehme.  
Col. Sir A. Phayre.  
A. Pilleau.  
H. Pilleau.  
Sir Henry Rawlinson,  
K.C.B.  
R. D. Sassoon.  
Major H. J. Sharpe.  
\*Col. Smith.  
G. P. Smith.  
J. B. Smith, M.P.  
Sir Macdonald Stephen-  
son.  
T. Stevenson.  
Geo. Stone.  
J. J. Stone.  
\*Captain E. Thackeray.  
Thos. D. Thomson, F.R.S.  
Edward Thomas.  
General Tremeneheere.  
G. O. Trevelyan, M.P.  
\*Sir Charles Trevelyan,  
K.C.B.  
S. Turnbull.  
Marquis of Tweeddale.  
\*Dr. Forbes Watson.  
Sir Andrew Waugh.  
Robert Whyte.  
G. F. Wilson, F.R.S.  
Sir Chas. Wingfield, M.P.  
E. W. Wingrove.  
H. W. Wimshurst.  
J. J. Wright.  
\*Sir Digby Wyatt.  
J. W. W. Wyllie, M.P.

Those gentlemen whose names have an asterisk (\*) have already consented to serve on the Committee.

The Committee resolved that Six Conferences should be held during the present Session for the discussion of the following subjects, viz. :—

Tea Cultivation in India.  
Hill Settlements and Sanitaria.  
Waste Lands in India.  
Trade with Central Asia, Thibet, and South-Western China.  
Indian Fibres.  
Silk Cultivation and Supply.

The following evenings were fixed for holding the conferences :—

Friday, March 12th.  
" April 2nd.  
" April 16th.  
" April 30th.  
" May 14th.  
" May 28th.

At these Meetings the chair will be taken at 8 o'clock, and the discussion will be opened by a paper.

On the first evening, March the 12th, Mr. C. H. FIELDER, Hon. Secretary of the India Tea

Association, will open the discussion with a paper "On Tea Cultivation in India."

The subjects for each subsequent evening will be previously announced in the *Journal*.

Members of the Society interested in Indian questions are invited to attend.

#### EXTRA MEETING.

Friday Morning, February 19th, 11 a.m.; A. J. MUNDELLA, Esq., M.P., in the chair.

The adjourned discussion on Mr. HENRY COLE's paper "On the Efficiency and Economy of a National Army, in connection with the Industry and Education of the People," read on Wednesday evening, the 17th inst., was reopened by

Mr. EDWIN CHADWICK, C.B., who said that the positions he had himself taken on the subject of army reform were supported by the testimony of distinguished military authorities. But the attack made by his friend, Major-General Sir William Denison, upon civilian opinion and intervention on army organisation, rendered it necessary to assert that the rule that every man is to be believed on questions on his own art and practice, is to be restricted to his art and practice as it is, and that when any question arises as to a change, or as to practice and art as it ought to be—the practical man was commonly about the last whose dictum is to be implicitly received, if it be against change—the last on account of the very extent and thoroughness of his practice and habits of mind, to judge competently and impartially of proposals of change in them. Hence, in the art military, as in other arts, the greatest improvements had been made by non-professional men. The famous naval tactic, the breaking the line, originated with a clergyman. The percussion lock was the invention of a clergyman. The most able writer on military education, a man of the highest judgment on military policy at this time, was a clergyman. A person who might have aided the present discussion with excellent suggestions on military reform, with good reasons from observation of the Prussian and the English army, was an army chaplain. All the professed artilleryists of this country, and of Europe, had been beaten in improvements of large, as well as of small arms, by which the future of wars must be largely changed, by a civilian, a mechanical engineer. The slowness and inaptitude of the military mind in this country to adopt improvements was shown in this, that it took nearly a quarter of a century of firing, by his old colleague in the civil service, Sir Francis Head, and also Sir Charles Shaw, to get arms of precision or the rifle substituted, as on the continent, for the smooth bore, the old brown Bess. To common perception the principle of the Colt's revolver commended itself at once for adoption for the longer small-arm. The principle of the quick breech-loader in the needle gun was sufficiently demonstrated practically by the defeat of a large body of Danes by a small body of Prussians armed with it at Duppel. But neither reasoning nor that demonstration availed until the great defeat of the Austrians by its use, when it was adopted in a fright and with a rush. On the great question of army organisation, the military mind was demonstrated to be entirely in default. Thus, it had been held by our highest military authorities, and held almost to the last as an orthodox professional opinion, on the American civil war, that the Southerners, from their greater practice in the use of weapons than the mere untrained shopmen and civilian volunteers of the North, must prevail. And yet more recently, this very question between standing armies and popular armies was put in issue between Austria and Prussia. All the present

advocates in this country of the standing army and depreciators of any popular army were loud in their anticipations of the triumph of the standing army of Austria, against which the armies of France and of Italy had prevailed with so much difficulty. When the trained men, enervated by the dissipation and idleness of the camps and cantonments of Austria, went down before the strong high-waged men, called immediately from the forge or the plough into the ranks of the popular army of Prussia at Sadowa, the authority of our advocates of standing armies went down too, and the modesty of the vanquished and prostrate in authority on army organisation now became them. He ventured to assert, with the support of reserves of strong military authority, that the late advances of large as well as of small arms, as led by Mr. Whitworth, must considerably alter old military practice and the war policy of nations, for whilst with the longer range and greater precision, these gave one to offensive war, they gave two or more to defensive war. In respect to fortified places this admitted of no dispute. There was recently a very able article in the *Journal des Economistes*, by an eminent military critic, which he (Mr. Chadwick) had shown to one of our generals of distinguished service, who expressed his concurrence in it, that under the new conditions, and with the new arms, an army of a hundred thousand men might protect France from invasion by Prussia, and that the great standing army of France was wholly unnecessary, except for the purpose of aggression and menace. Sir Charles Shaw had cited to him the opinion of an able American general, who had recently visited England, and who ridiculed the idea of the success of any invasion of it, as against its present defensive force, lining the hedges, the walling, the farmeries and buildings of the cultivated districts with breech-loading small-arms; and this American general based his conclusion (in coincidence with that of the French authority) on the fact, that during the civil war neither side did or could make way against the other in such cultivated country. Another new condition now demonstrated was that the new arms—which are yet advancing with science—require more and more of intelligence, coolness, firmness, and skill to wield them. General Hay or Colonel Wilford would, no doubt, attest the fact that as a general rule the figure of merit in shooting is almost as the figure of education and intelligence; it might be almost of morality, for the fast man, of shaken nerve and flurried passion, would go down before the temperate man, of intelligence, coolness, and steadiness. Sir Wm. Denison had spoken of our present system of a standing army as befitting our race. Why, if he went back to the history of our most warlike times, it would be found that—not a standing army—but a popular army, based upon a popular general training, was peculiarly fitting to our race. If they would read the work of Roger Ascham, the tutor of Edward the Sixth and of Queen Elizabeth, on commendation of training to the use of the bow, they would see how curiously analogous were the conditions and qualities to those now required, and in which our people were most successful in the use of the rifle. In sedulously promoting and enforcing military training in the juvenile stages of the whole population in all parishes, as described by Bishop Latimer and Roger Ascham, the Plantagenets and the Tudors well knew what they were about. The good old bishop had thus described our early national practice, in a sermon preached before Edward VI.:—"The art of shooting hath been in time past much esteemed in this realm. It is the gift of God that He hath given us to excel all other nations withal; it hath been God's instrument whereby He hath given us many victories against our enemies. . . . In my time my poor father—a yeoman, who had no lands of his own, only he had a farm of three or four pounds by the year, at the uttermost—was as diligent to teach me to shoot as to learn me any other thing; and so I think other men did their

children. He taught me how to draw, how to lay my body to the bow, and not to draw with the strength of arms, as the other nations do, but with the strength of body. I had my bows bought according to my age and strength; as I increased in them so my bows were made bigger and bigger, for men never shoot well unless they be brought up in it. It is a goodly art, a wholesome exercise, much esteemed in physick. In the reverence of God let it be continued." Now whilst the advance in science and the new weapons requires higher and higher qualities of intelligence and steadiness to wield them, the economical conditions of the country, the increasing demand for labour, the advance of wages, notwithstanding the recent depression, would only leave the lowest dregs of the uneducated population to draw from for any standing army maintained upon the existing footing. Sir William Denison had denied the justice of the comments made on the character of the ranks. But here was an account of them given by a military organ, the *United Service Journal*, for July, 1861:—"The army as a service, even with limited enlistment, has not become more popular, nor has a better class of men been induced to join it. On the contrary, in both these respects it has decidedly fallen off. It is no easy matter, if any pressure prevails, to get a sufficiency of men to enlist at all, and every one who knows anything about it will say that our soldiers are far more than they ever were the very scum and dregs of the population. Ticket-of-leave men abound amongst them. One half the recruits raised are practised rogues and vagabonds; they only enlist for the purpose of getting the bounty and deserting immediately after. The numbers who are said to have done so, upon the authority of official documents, during the last year, were no less than between 20,000 and 30,000." It was then, of necessity, that this condition must be reversed for the future of war; that we must have more of intelligence for the ranks. Would any one assert that there would not be, even now, a large difference in the military work, say with ranks composed of men equal in intelligence, which is what is wanted of corporals and sergeants? But the country cannot afford the money to pay for a standing army of this quality, and must depend for it mainly on volunteering, which already had nearly attained it. In these conditions he had proposed to transfer, as much as possible, of the military drill exercises from the adult or productive to the unproductive or the school stage. What might be done in that stage was proved by what is done in the district half-time schools. Sir William Denison stated that boys were drilled, some sixty years ago, at the schools, and that he had not heard that much was done by it. Sixty years ago the military exercises were confined to a comparatively few schools, but he had the information of old men learned in those schools that they animated them. There could, however, be no doubt of what it does now. Boys so drilled volunteered in large numbers for the army and for the Royal Navy; indeed, in such numbers as to induce guardians and other employers interested in the local labour market to check their departure for the services. All conversant with the military training would attest that the younger you begin the better you do with the children, and that they do in the infantile stage what they cannot do in the adult stage. In the one stage they had the tender twig to bend, in the advanced stages, the knotted stick, or the gnarled oak. Mr. Cole had proposed to begin the training of children in the military drill at ten years of age. If he had consulted the practical experience of drill corporals, he would be aware that they find they can begin well with children, with some exercises, at five years and a-half or at six years of age, and that by ten, or a little after, they impart to them a very advanced drill indeed, and practice with light rifles. It was proved that we can drill about one hundred and thirty children in the school stages well, at the cost of keeping and drilling one militiaman, in the adult stage, comparatively hopelessly ill. We could, moreover, im-

part to three lads the efficiency of five for all ordinary labour. We imparted to them the moral qualities of self-restraint, patience, attention, and prompt obedience. Hence, if we had no prospect but of perpetual peace, the training in the school stages would be abundantly worth while, as means for increasing the productive power of the country. He submitted the question of the military policy of this measure to Sir John Burgoyne, and to other distinguished generals, and received from them expressions of concurrence. Amongst these was the late Lieutenant-General Shaw Kennedy, one of the Duke of Wellington's most able officers, and a writer of high authority on military policy. That officer denied our power of maintaining a large standing army on the footing of the present. He (Mr. Chadwick) begged to cite his conclusions sanctioning the propositions:—"According to the principles which I have stated, there will in future be required to be held constantly in readiness for the protection of this country a very large number of men who have undergone a certain extent of military training, and who are organized, in addition to the regular army of the country. This, in my opinion, will be a sufficient protection to the country without the employment of a large standing army. Having stated these principles, I am now able to give direct answers to the questions contained in your letter. It is evident that if a national force is in a great part to be substituted for a standing army for the defence of the country, the more that national force is drilled, disciplined, and made acquainted with the use of fire-arms, the better; and I say, without hesitation, that I conceive no other plan would accomplish this so thoroughly as that of military exercise being made part of the course at school, as proposed by Mr. Chadwick, if such a system can very generally be introduced. I have read over with great care the three heads under which Mr. Chadwick classes the effects of such a system as part of the education at schools—viz., 1. Physical and Sanitary; 2. Moral; 3. Economical and Productive; and it seems to me that his inferences under those heads cannot be controverted." The evidence and the conclusions he had stated on this topic, in connexion with half-time teaching, had been adopted, and were in action in several of the New England states, and also, he was happy to say, in Canada. He had been in a position in poor-law administration to deal with large numbers of army pensioners, and the fact was that the disbanding of a standing army kept under existing conditions, unused to work, might be said to be the creation of an army of miserable, dependent paupers, or mendicants. The reverse was the case with those who were employed in productive public work, or who were to employ themselves in private work. They were better men, as well as better soldiers; better for productive work, instead of the worse for their military training. He therefore proposed, for the benefit of the army, and the relief of the taxpayer, that men should be allowed and encouraged to leave for any civil work on long furloughs, with the condition that they should return to their colours periodically, for terms of exercise, and any new practice for which an amount of exercise, that now served for the militia, would probably suffice. He had cited, in support of this practice, the example of Sweden, which probably did not keep more than one-third of its force in camp, the rest being out in productive employment, to the relief of the tax payer, as well as to the benefit of the soldier; and Sweden, like Switzerland, on this system, had a formidable army, which might be found not to have degenerated from that which fought under Gustavus. This system, which brought higher qualities into the ranks, might be regarded as a more extended development of our great volunteer system. It was to be expected that by the general and thorough adoption of military exercise in the school stages, little of compulsion or of the dreaded inconvenience of a conscription would be needed. He proposed the same principles of encouraging occupation in civil or private service as applicable to officers as

well as men. The experience of India had proved that the employment of officers in public works or on civil works during peace was a far better preparation for war than the routine of the camp and the standing army. Lord Napier, of Magdala, who had for twenty years been engaged in making roads and bridges, was an example of this. In war the proper use of the railways was of course an important means. Captain Tyler, of the Royal Engineers, had, in civil service, obtained a great mastery of our railway system, and having come to the term of his "seconding," was obliged to leave the service. This was an example of the Horse Guards and the War Office administration, which was condemned by Sir John Burgoyne, as depriving the service of valuable skill and experience. It was clear that as men could not be got to stand up in ranks, to be mowed down by the new arms of long range and precision, new wars would become very much, as they recently became in America, a war of earth-works, or of engineers, and that whilst for the ranks, men in practice of civil labour, in the effective use of the spade and the pick, would be required, as shewn in the Crimea, where an army was nearly lost for the want of a road—which the dead men and the dead horses occasioned by the failure, might have made if it were a popular army—an extension of engineering and scientific commands would be needed. In America they had by their losses been driven from common commands, with no better qualifications than those of our line officers, to scientific commands—to engineers (West Pointers as they were called); and of these West Pointers, every one who succeeded had been occupied, not in mere routine, camp, or barrack duty, but in civil work of one sort or other. Grant had done work as a private surveyor as well as a leather seller. Others had done railway work. A reform in the principles established would enormously reduce our taxation, increase our military efficiency, and augment our civil productive power.

Major-General Sir WILLIAM DENISON would still maintain that the army were not such blackguards as his friend Mr. Cole wished to represent them. If 20,000 went out from the army every year it was evident that they got rid of them, but he begged leave to doubt the fact, and if they did go out the better ones remained behind. They constantly saw old soldiers acting as servants, and in various situations of trust, and he maintained, therefore, that it was not a fair representation of the army to say that they were a mere set of ruffians picked up in the streets. He did not at all object to carrying out any system of military drilling in schools, but he must say that when he was a boy he did not like it, especially as it cost him a portion of his half holiday. He did not object to such training of the young, but he did not think it gave them much of a military spirit. Coming more immediately to the proposition of Mr. Cole, he would look at it first in the light of economy. Mr. Cole proposed to disband the army, and if so they would be at once an army of paupers; then out of that 130,000 he proposed to select 16,000, which was to make a *corps d'armée*, but in addition to that they must have a proportion of cavalry and eight batteries of artillery, certain companies of sappers, and so on; and then they would form the pattern army. But if after that they were to have 1-13th of the whole population trained in arms, it would be equivalent, as said the other night, to the whole male population between the ages of 16 and 26, numbering in all about  $2\frac{1}{2}$  millions—in point of fact, there would be two millions of men who would each have to spend one year of his life in learning the drill, so that there would be two millions of men's time to be paid for annually in some way, and that, he did not think, would be very economical. He wanted to know what was to be the efficient army in case they were called upon to serve; the 16,000 or 20,000 men was only a sample. Supposing a fleet came over and landed 100,000 men on our shores, what would there be to meet them with? Were the two millions of men to be called out?

If they were, they would require officers and rifles, and there must be artillery and cavalry horses. Then, what proportion of the two million would be trained in the more technical branches of military education; as, for instance, that relating to artillery? You could not make an artillery man in a year, nor even in five years; and yet these men must be ready at a moment's notice if they were to be of any use. Before the days of Buonaparte, as a rule, the proportion was two guns to a thousand men, but latterly there had always been three guns to 1,000 men, so that if there were 200,000 men, they would want 600 guns; and the guns would require carriages, horses, and harness, all ready at the moment. Then, again, the engineers would require a certain number of companies of sappers, and so on, and there must be officers to command them; and all this must be part and parcel of the steady outlay of the country. He was an engineer, and had been in the habit of making estimates, and he took credit to himself for having seldom exceeded his estimates; he, therefore, looked closely into the items of expenditure, and it had occurred to him that Mr. Cole's was a mere civil engineer's estimate, which was, generally speaking, doubled when it came to be put in practice.

MR. COLE begged to remind Sir William Denison that he had provided for all these matters which he had alluded to.

SIR WILLIAM DENISON said if that were so, he had left out other large items. All these items which he had mentioned formed a very large portion of the outlay of the army, and were matters which every officer worthy of the name had carefully to consider and look into. It was on that ground that he objected to persons who knew nothing whatever of these details professing to give an opinion which should be of any value. He would not prohibit any person from professing his opinion; but he protested against having to adopt it. His opinion was formed on experience and knowledge; and he must again repeat, that if he were to go into a tailor's shop and insist upon teaching him how to make a coat, he would, very properly, be considered a great ass. If he were to go down to the establishment of his friend in the chair, and attempted to teach him how to conduct his factory, he would no doubt intimate to him, more or less politely, that he did not know what he was talking about, and had better leave him to conduct his own business. Mr. Cole had laid great stress upon the principle that these details should not be discussed; yet, in point of fact, the whole discussion had turned upon detail. He would not say anything more on the question of the army, but he should be very sorry to give a contract to Mr. Cole to provide an efficient army for seven millions; at any rate he would not give him the contract without first-class sureties, and a guarantee from their friends on the Continent and in America that they should be left quietly alone for the next ten years. Another important subject was that of the defences of the colonies, and he must say that this had been dealt with unfairly. People left England and organised a community—that community was part and parcel of the empire, and it was to a great extent our colonial power which enabled us to keep up our prestige throughout the world. We were known as possessing an empire on which the sun never set. Although the French and other nations tried to follow our example they tried in vain. Would it be fair to set these communities adrift and subject them to all the risks which would follow if England went to war? They would suffer, and yet they had not a voice in saying whether or no we should declare war. He was alluding especially to those large countries which were said to be under responsible government. They built barracks and batteries and did all local works that were necessary, and, in part, supported the troops who had to defend them. It would be very unfair to say to them that they must pay the expenses of defending themselves, while, at the same time, they had no voice on the

question of declaring war. If England were foolish enough to give them up, and if they were foolish enough to accept their independence, the result would be a heavy pecuniary loss to both. Supposing we withdrew our troops from Australia, and told the colonists they might make their own arrangements and become independent, in the first place we should lose zealous and affectionate friends, for in Australia the feeling of affection for England was universal, and she was still regarded and spoken of as home. If England had been wise enough not to quarrel with America in the last century, there would, no doubt, now have been an English race able to dictate to the whole of the world. Again, as regarded economy; at present the trade with Australia was protected by a couple of corvettes, but if those colonies were made independent, we should at once want a fleet to protect not only their trade *but our own*. On their side, again, they would lose the protection of England, which now stood between them and harm. It would be a great folly to give up all those advantages on both sides on the miserable, petty, and selfish plea of economy. In 1846 he went to Australia, and having inquired into the general state of the trade, and the relations of the colony, he found that the annual increase of English capital was then about 20 millions. On coming here in 1866, he was told that the annual surplus increase was now about 100 millions per annum; and while this was the case, and we were thrusting out our surplus wealth and trying it all over the world, he would suggest that the better plan would be to spend a little of it on our own people. One word with regard to education. If the army was to be a popular army, it was much insisted upon that it must be an educated army, but the army consisted of a certain class of people who were picked out from the rest of the community, and unless the population were educated, we could not hope to have an educated army. There was a good deal of talk lately about educating the population, but he begged leave to express an opinion that there was not one in ten of all these people who wrote and talked so much on the subject of education who had the least idea of the true meaning of the term. Reading and writing and arithmetic were not education. His definition of education was to teach a man, in the first place, his duty to God and his duty to his neighbour, and when they had done that they might superadd to it whatever training was necessary to fit him for the situation in which God had placed him. As to teaching a ploughman geology, or any of the other "ologies," it was simply absurd. Teach him to do his duty in the situation that God had placed him, and he would be a well educated man, but try and cram more into him, and you would make him a dissatisfied fool.

MR. CONNOLLY said that as a working man he took very great interest in the economy of the public expenditure, because he believed if the working classes were to be fully employed, and not to trust to Government for a proper sustenance for themselves and their families, they must be governed much more cheaply than they were at present. Now that the Government were making some efforts towards economy in the several departments—it was said that quills were to be mended, and that only one leaf of paper was to be used instead of two—he hoped the same would be extended. He had a great regard for Mr. Cole, who was a gentleman who had not made many mistakes in his life, but on this occasion he had made one of the greatest imaginable, that was to say, that he ought to have read this paper about three months before Mr. Gladstone formed his Cabinet, and then it was ten to one but he would have been one of that body in place of Mr. Cardwell. His suggestion was something like economy, knocking off seven millions at once, and he believed that at no period had this country been so favourably circumstanced for a sweeping economy as at present. They had peace all over the world, and the principles of statesmen—of acknowledged statesmen—now were peace

at home and non-intervention abroad. The colonists were to be no longer dragged at our heels—they were to be self-governing, and, if possible, self-defensive and self-dependent. This was illustrated in the case of New Zealand, for England had taken away the troops, and this colony, which, according to Sir William Denison, required more protection than any other part of the empire, would be left to the efforts of the colonists themselves, and they would have to fight their own battles if they were to reap the rewards of their own industry. He had been rather loth to interfere in this discussion, owing to the observations which had been made about the tailor, especially as he was a stonemason himself, so, therefore, perhaps, the cap fitted him, but when he recollected that the President of the United States, the commander-in-chief of the army of the United States, had been a tailor, he was emboldened; and, in addition to that, his memory served him to a little illustration, gathered from his early life in Ireland, which, if it did not demonstrate the valour of a tailor, certainly went to show his prudence and foresight. During the rebellion in 1798, there was a certain dandified young officer who came over to take the command of a company, and, not being accustomed to fighting, thought he would make some little preparation to guard himself from the pikes of the rebels. He accordingly instructed his tailor to put in the breast of his waistcoat a nice piece of polished steel, but, from some mistake or other, the tailor put the plate in the back part of his trousers. It appeared that shortly afterwards the company was called into action, and meeting with a strong force of rebels he had to make a retreat. In getting over a hedge at the extremity of the field, he was overtaken by one of the rebels, who made a dash at him with his pike and pushed him over, feeling certain that he had killed him, but the young officer scrambled to his feet and made off, remarking to himself that the tailor knew where his heart lay a great deal better than he did. He believed the English were of all nations on the face of the earth the most capable of defending themselves. They stood alone, surrounded by a moat, wide and deep enough to submerge all the armies in the world, and as long as they had to fight they asked no better foe than to see 100,000 Frenchmen land, and he was quite certain they would never find their way back again. Sir William Denison had deprecated the idea of any man interfering in military matters who was not bred up to it. In matters of detail and discipline that might be so, but surely the War Department was managed by civilians, and had been so for many years. Whatever was the present management, it appeared that they had produced the least efficient and and most expensive army of all Europe. Our object was to get something better and cheaper if possible, seeing that we had no reason to fear war abroad, and that our colonies were to be made self-supporting, which, if they were made independent to-morrow, would be as much advantage to the mother country as they were now, so that there was no reason why a vast reduction should not be made in the army. He contended that it was no advantage to have the colonies dependent; therefore, as we did not mean to be aggressive, and as we were defended by an ocean, and had a warlike, stalwart population, such as no nation in the world ever exhibited, including the sober, steady perseverance of Englishmen, the light step, and active lively spirit of Irishmen, and an evenly-balanced combination of both in the Scotch—with all these elements, and a good navy, we might bid defiance to the world. The real question at issue, then, was how best to take care of ourselves. Ireland had been looked upon as one of the most incorrigible portions of the empire; but it was found that during the late attempt at rebellion by 10,000 or 12,000 natives of the country, the Irish constabulary managed to hold it for the Crown. Sir William Denison had argued that a system which was applicable to France and Prussia would not

suit England, and had spoken of the great difference of race between the Irish, the English, and Scotch, and so on; but, to his mind, there was no more difficulty in combining these different elements than those which composed the empire of France at the present day. Normandy, Provence, and other parts of France were as completely distinct nationalities in the middle ages as England, Ireland, and Scotland were at that time. Now they were all thoroughly incorporated as Frenchmen; and Prussia also was made up of different provinces and different nationalities, and he believed it was that very army system which had prevented the unity of the different portions of this country. He believed that heretofore the country had never been governed according to a sense of justice, but it had been governed by a class, and in the interests of a class; and while this was the case, the government had to be supported by hired soldiers. They dared not trust the defences of the country in the hands of a national army. But now they were coming upon brighter times, when the programme upon each side of the House was, "We must widen the basis of the constitution," and when it was understood that the fast line of demarcation which had heretofore existed between different classes must be blotted out. If the empire were to be governed on principles of justice and equity like that, there would be no need of a standing army to keep the people in order. He was not competent to enter into the details of Mr. Cole's scheme, but he believed that a very small army, such as he advocated, would be perfectly capable of keeping order in the country. They knew what great difficulty was thrown in the way at the commencement of the volunteer movement, but still it had extended, and was extending; and if twice as much money were expended as there was at present, and they did twice as much drill, and made it a rather more business-like affair, and not so much an amusement, it would answer nearly every purpose that was required, which was simply that of defending the country. As for maintaining an army for offensive purposes, we never did, and never could. In older days, it was true, when the soldiers were wrapped-up in steel, they did go and make war on the Continent, but they could not stop there, and ultimately the idea of aggression was given up. If we desired to retain our colonies, they, of all places in the world, were most easily defended. Suppose 5,000 Frenchmen were to land in any of the West India Islands, we should only have to send over a number of iron-clads, and keep them there while they starved. No nation could carry on a war of any extent away from the basis of operations, and no nation would ever do a worse day's work than to attempt to invade one of our colonies; therefore, there was not the slightest necessity to keep up a large standing army for the protection of our colonial dependencies. He had no doubt that, if Mr. Cole's idea was taken up by military men who were capable of working out the details, they could make a most efficient system of defence for this country, and at a considerable saving of expense. If we were to hold the first place among the nations of the earth it would not be by arms, but by our industry. As long as he had to pay about one-fourth of the rent of the little house he occupied, in the shape of taxes, in addition to the indirect taxation, so that an income of £2 a week now was not worth any more than 30s. was when he first came to London, it was evident that the price of labour must be kept up at a very high rate, and, while that was the case, we could not go into the markets of the world and sell our goods at so cheap a rate as to be able to compete fairly with foreign countries. In conclusion, therefore, he would only say that any question of this sort, which tended to greatly reduce the national expenditure ought to receive the fullest and fairest consideration, and he hoped that Sir William Denison would use his influence with some of the scientific gentlemen belonging to the army, and induce them to take this matter up, and see what they could do to carry it into effect.



Dr. STALLARD said he should not have addressed the present meeting, but that he had had various opportunities of seeing some of the defects of the present system, and he would, therefore, make a few observations, although, like the last speaker, he must reckon himself in the category of the "tailors." He would suggest, however, to Sir W. Denison that this was not a matter really of detail, but of general principles, and, therefore, he did not think the illustrations really applied. It was not quite true that if a man's coat did pinch under the arm the best plan would be to have it let out; but what if the coat was not as good as it might be, supposing it were too narrow across the back, and too large in the waist, and too long in the tail, and that when it was put on it could not be made to stay unless it was tied with a vast quantity of red tape, which prevented its being used with any comfort or advantage; under such circumstances he should think they would be perfectly justified in going to somebody else to provide them with a better material, and to alter the coat altogether. First of all, with regard to the recruiting system, Sir Wm. Denison had told them that the character of the army was the character of the labouring population, but if that were so, he believed it would be very different from what it was. It could not be denied that the system of recruiting failed to bring into the army a fair specimen of the labouring population of the country; a very small proportion, indeed, could read and write, and not more than three in ten were connected in any way with the mechanical or artisan class; and the proportion would not be so large as that, but that certain higher branches of the service, such as engineers, were included in the calculation. There was abundant evidence to show that the character of the men in the army was not what it should be. The fact of 20,000 soldiers going through the prisons annually was doubted, but there were rarely less than 4,000 in prison at one time in this country. While the strength of the army was generally about 60,000—it appeared by the last report of the medical department to be 57,000—he would ask whether there were any class of labourers in this country numbering 60,000 of which 4,000 were constantly in prison? The cost of these prisons and of the administration of justice was no small matter, besides the withdrawal of such a large number of men from their duty. In addition to the cost of the prisons themselves, there were the extra charges for the officers in charge and various other expenses connected therewith; but the mischief did not stop there, for the consequence was that every soldier was treated as a rascal and blackguard from the very hour he entered the service, and never was considered in any way capable of taking care of himself, either physically or morally. Just look at it from a medical point of view. There were always a large number of men in hospital, and this necessitated an immense expense for medical men and hospital management. If they treated soldiers on a different system altogether—a system of confidence, such as was pursued in some of the continental armies—an immense deal of this would be saved. A great number laboured under perfectly preventable diseases, dependent on want of self-control; in fact, one-third of the admissions into hospital were cases of this kind, which he did not believe could be said of any portion of the agricultural or artisan classes of the country. The same remark applied to many other cases of disorder. If a man had a sore throat he must be sent to hospital, because it was supposed he could not be trusted to take care of himself in the barrack-room. As soon as a man was enlisted, he was put into a room where he had to associate with 14 or 15, or 25 men, and from that hour he never had an opportunity of being alone, except when he was put into the cells. These cells, again, were constantly in requisition, and the number of men confined in them must be added to those in prison to show the total who were withdrawn from duty. When a man entered a barrack-room he entered a regular Pande-

monium, which no one could describe except those who had lived in it. Men had told him that no one could imagine what they suffered for the first few weeks. Although this was a system which might raise the blackguard to a certain point (but, as a rule, the moral standard of the barrack-room was the standard of the lowest in it, and not that of the highest), all these things must affect the character of the soldier. Then, as to his duties; it was recommended some years ago that the men should be taught industrial arts, and he believed £1,000, or something like that, was expended in industrial teaching, which was utterly absurd, if any good effect were intended. A great part of the men who entered the army had no knowledge of any handicraft or trade, and therefore there was a better opportunity of improving them if they set about it in the right way. When he went over the barracks of the Marine Artillery, he found that, out of 14,000 men, between 500 and 600 were employed every day in erecting buildings of different kinds, and so on, and if this system were carried out throughout all divisions of the army, it would have an immense benefit in every way. As it was, those engaged in the guard-room were lying about in all directions, having really no occupation. He could not imagine any system in the world more likely to lead these men into every species of vice; and it was this which, in a great measure, necessitated all this complication of hospitals and prisons. Some of the military arrangements were perhaps the most insane things that could be suggested. If they went to Dover, they saw a man standing in a corner of a little cliff, by the side of a gun, not having the slightest idea of what he was doing; and there he was, night and day, according to circumstances, in wet or fine, hail or snow; and after having been there for two hours, he went into the guard-room, which was a place as hot as an oven, from which he again went into the cold air, and the consequence was that he often caught cold, and had to be sent to the hospital. The whole system of guard-rooms was to him a complete mystery. He had noticed at the guard-room at Dover there was an officer who was in charge for twenty-four hours, and his duties could have been equally well done by a couple of policemen. Then, again, how bad was the system of discharging the men who had broken down, and were unfit for duty, in consequence, very often, of the exposure to which they were subjected. How many went away with a paltry pittance of 6d. a day for twelve months, and then after were left to be paupers. If the men in the army were properly trained, and regarded as men, the army was capable of being made into a great educational power, for a man who had been properly drilled in habits of obedience and discipline, and educated in other ways at the same time, would be turned out a better member of society in all respects, instead of being turned out as he was now, a pauper on the parish. Then, on the question of marriage—and this, he believed, lay at the bottom of the whole system—out of the 57,000 soldiers in this country, between 8,000 and 9,000 were acknowledged to be married men, while, in all probability, there were 1,000 or 1,500 men who were married but not known to be so; so that at least there must be 10,000 married soldiers in England; taking the average of two children to each, there would be something like 20,000 children. The consequence was that with those 57,000 soldiers there were associated no less than 30,000 women and children. Why, the very idea would be laughed at either in France or Prussia. The army was seriously impeded by this great number of women and children, and an immense expenditure was added in every way in consequence. A few years ago, no attempt was made to recognise the fact that there were women and children connected with the army, but after considerable pressure had been put for some time an attempt was made to do so, and Parliament made a grant for the purpose of providing accommodation for married people in the army. Of course, if it were right that married people should be provided



for, it ought to be done thoroughly, instead of which, as he had seen in more than one instance, there were often three or four married couples in the same room. At the present moment there were a great number of married couples not provided for in any way, who had to be lodged in single men's rooms. In addition to the grant of £30,000 a-year, there was a considerable amount to be added for repairs, for it was generally found that children were very destructive. Then, again, female hospitals were required, for, although until very lately the women had had to lie in the ordinary rooms, an attempt was now being made to provide separate accommodation in the shape of hospitals for them. This also required a gigantic system of infantile education. He had known the case of a colonel, the greater part of whose time was taken up in the inspection of infant schools, for it seemed to be considered that it was absolutely essential that a special school should be provided, sometimes side by side with the national school. Then, again, there was an enormous cost in the continued removal of these 30,000 women and children, it being the system to move the soldiers about every six or twelve months. He thought the system proposed by Mr. Cole and Sir Charles Trevelyan was the legitimate mode of meeting the difficulty. If young recruits entered the army at about 21 it would be no hardship to expect them to remain for two or three years single. In his opinion the army would never be what it ought to be until the feeling was that for a man to be turned out of it was the greatest punishment that could be imposed upon him. He had put himself in communication with officers and privates in the Royal Artillery, which consisted of a better class of men, and he had ascertained that when the system was introduced of discharging a man who married without leave, it was soon stopped. He did not quite go with all the suggestions of Mr. Cole, but he quite agreed with the observation that the home army and that required for foreign service should be on an entirely different footing altogether. If the army were established on a proper basis he did not believe there would be any difficulty in finding men, for, in 1852, in the county of Leicester he raised 1,200 in less than three months for the militia, and he never looked at a man who did not measure 5 feet 5½ inches, and rejected many because they did not bring sufficiently good characters. He hoped this question would be thoroughly ventilated, and would not be allowed to drop.

Colonel LEAHY, R.E., said he had given the subject considerable attention, and he was sorry that the discussion had digressed so much from the points and principles put forward by Mr. Cole. Having briefly recapitulated the main points of Mr. Cole's proposed scheme, he said in the first place he altogether dissented from the idea that such a discussion was to be limited to military men, and considering the successes which had attended the department to which Mr. Cole was attached in spreading a knowledge of art throughout the country, he hoped that his suggestions to improve the military art would meet with due attention. He believed the simile of the tailor had been misapplied, not only by Sir Wm. Denison, but by most of the speakers. They did not ask the tailor whether they should have a big coat or a little one, or what sort of cloth it should be made of; that was a question which they decided for themselves; and on the same principle he thought it was quite right that civilians should discuss what sort of defences they should have. Mr. Cole had been good enough to refer to a paper which he had lately read, on the subject of the organisation of the army, and he simply referred to that to show that he had divided it into three branches, only one of which he had taken up, so that the remarks which he had then made had reference only to the existing numbers as they were decided by the authorities. He expressed no opinion as to what the numbers ought to be under a different system. The principles to which Mr. Cole called attention was by no means novel, for 23 years ago the subject

was discussed with reference to the *Army Service Act, 1847*. The reason for the introduction of that Act, which provided for a limited term of enlistment, was to induce a large proportion of men to enter the army, and to cause it to be a punishment to be turned out of it. It had also the object of providing a larger proportion of men for the Military Train, and of encouraging men to join a reserve force. It also recommended that men should be taught some industrial employment, so that, when they were discharged, the estimates would be relieved of a portion of the non-effective department. Nearly all these suggestions were taken into consideration by the Recruiting Commission of 1866, and it might be interesting to the meeting to state the conclusions which wound up their report. These were, in the main, that we must not rely on having time to prepare for war, which in the future would be sudden in its commencement and short in its duration, so that under these circumstances we could not regard the army at its present strength as sufficient for more than a time of peace. The question was discussed how it should be increased by means of reserved forces, and of insuring the service, when required, of men who had already served and gone back to civil life; but it was very astonishing to find that, at the conclusion of all, it was stated that measures already proposed to induce men to re-engage, still further tended to check that increase, and under these circumstances the Commission were not prepared to propose any plan as likely to secure any large army of reserve. That was the result they arrived at, and it could not be put too plainly before the country. It might be doubted whether it was good policy to induce men to re-engage, which involved the question of providing them with pensions. No doubt the principles which were advocated by Lord Grey, and concisely stated by him in a letter appended to the report of the Commission, were the right principles to adopt. It appeared that the volunteers cost £1 10s. a year each, and the militia soldiers £6, and of these 70,000 were in training. Now it appeared that the 6,000 permanent staff cost a great deal more than the 70,000 who were called out for training. The sum expended for training was £194,000, as against £205,000 for the permanent staff of 6,000, and this was irrespective of the cost of barracks, or anything of that kind. His opinion was that, considering the large proportion of officers in the army, the training of the militia ought to be provided for out of the regular forces; and, if that were done, he believed the expense of the militia could very well be reduced to about £3 per man. He had gone into the figures somewhat closely, and he found that a young soldier cost, on first joining the army, including everything personally to himself, about £32 a year, but the re-engaged soldier cost about £40, so that, in place of re-engaging the men, they sent them home and took new men. To a certain limit he agreed with Mr. Cole that young soldiers should replace the old ones, but as regarded the scientific and special corps he should certainly rather go in for quality than quantity. There was another point of great importance which he much wondered had not engaged the attention of Parliament. It appeared that in one year they had re-engaged 30,000 soldiers, and those had a right to a pension some ten years hence, the capitalised value of which would be about £130,000, that was the capitalised value of the effects of one year's re-engagement, and that really ought to be put into the Post-office Savings' Bank, if they wanted to provide for the amount of their pensions. As far as he could make out, some 26,000 of those men would be alive ten years hence, and their pensions would then amount to half a million a year, while in twenty years there would be 23,000, and their pensions would be £450,000 a year, so that at that rate it would be a long time before Mr. Cole got down the estimates as he proposed. There was an immense amount paid for non-effectives in connection with the army, and he believed it would be a good system to remove these from the

army estimates altogether, and let them be administered by the Treasury, with the advice of the Chelsea Hospital Commissioners, in connection with the Post-office Savings' Bank. When a man was taken into the army the capitalised amount of his future pension should be paid over to a separate fund, so that the army estimates should simply bear the expense of effective men; in round numbers they now paid thirteen millions for an effective force. Mr. Cole put it at eight millions, but he did not think it possible to get it down so low as that.

Colonel MAUDE, R.A., without endorsing the whole of Mr. Cole's scheme, would say one or two words in favour of it, as affecting the position of the men. Officers were very advantageously circumstanced as compared with the men. As soon as they had finished their drill or other duties they knew how to employ their time, while the men had no such advantage, and for want of having other resources they took to debauchery, which ended in the crimes to which Dr. Stallard had alluded. The figures, however, which had been stated with regard to crime in the army, must not always be understood to mean what they appeared to mean; for instance, when it was said that one-fifteenth of the army passed their lives in prison, it must be understood that almost all those crimes which entailed imprisonment were caused by drunkenness, and the necessity of military discipline visited the offence of drunkenness much more severely than was the case in the general community. He ventured to say, that if artisans, or even the upper classes, were judged as severely as the soldier in that respect, there would be a great deal more crime appearing in our annals. He became interested in this subject by personal experience; and some years ago, when a superior officer of his insisted on his attendance between ten and one every day at the barracks in case an officer was wanted, in addition to the regular drill or duty, he found this was the most cruel thing which could be inflicted, being, in fact, simply enforced idleness;—there was nothing to be done, and no opportunity for study or recreation of any sort, and then it occurred to his mind that this was what the men had to endure throughout the whole of their career. A great deal had, however, been done lately for soldiers, and their pay had been increased 50 per cent. within the last two years, and a great deal also had been done in the way of education; but, at the same time, he was sorry to say that the crimes which were spoken of, connected with idleness, rather increased than diminished, which would appear to prove that neither money nor education were of such value as moral instructors. There were two things which he thought would do great good—one that of having the fixed hours for military exercise more clearly defined, and the other of employing the men in different industrial occupations. He might mention that some years ago he had to do with the getting up of an industrial exhibition for the regiment he belonged to, in an out of the way part of the world, but it failed, simply because the men did not know any trade at all, and yet they were supposed to be superior to the ordinary run of the army. Another thing to be borne in mind was that Englishmen seemed particularly adapted for out-of-door labour. It was found that even factory operatives in a very short time became thoroughly competent agricultural labourers, and as skilful as any peasant. He would therefore suggest that farmers in the immediate neighbourhoods of camps and barracks should be able to obtain the services, when they were required, of a certain number of soldiers, so many hours a week, at so much an hour, which would greatly facilitate many agricultural operations. It would also be very easy, as suggested by Mr. Chadwick, to establish a contract with railway companies for taking the men at very much reduced fares where they had to go a considerable distance. On this matter he could speak from experience, for he had lately found that one of the large railway companies was very glad to enter into an arrangement of this kind; and where rough work was required the men

could easily be supplied with a strong suit on purpose, which could be paid for out of their earnings. Employment of this sort should be purely voluntary, and allowed as a reward for steadiness and efficiency. He believed that such a plan would have very good effects both upon the soldiers themselves and the employers of labour, and would tend to bring large portions of waste land into cultivation, and also raise the wages of the agricultural labourer. It would also introduce the system of piece-work in this kind of labour, which was now introduced in Australia, New Zealand, and Canada with very great advantage. It would afford a stimulus both to farmers and labourers, would diminish idleness amongst soldiers, and would render them capable of earning a livelihood as colonists, and he believed it would render the army very popular with all classes.

Captain BEAUMONT, M.P., would not venture to express any very decided opinion as to whether Mr. Cole's system was right or not, but he must controvert the assertion made in the paper that a subaltern had only one hour's work a day. He had just come from Sheerness, and it happened that he was very fond of playing rackets, but the subaltern on duty had often told him he could not spare even half-an-hour to play a game with him. If they looked at the duty subalterns had to do, it would be found that it represented an amount of bodily labour which was not by any means consistent with the low rate of pay which they received. It was said that a soldier was looked upon with suspicion, but as an officer of 17 years' experience, having been always what is called a sentry-going man (that is, one always on ordinary duty), he distinctly denied the assertion. It was perfectly true that they had to deal with what unfortunately was the scum of the population, and he would not say whether or not that should be remedied, but considering the material they had at their disposal, it was dealt with in as kindly a way as was consistent with due and proper discipline. He quite agreed with what had been said by Dr. Stallard with regard to married quarters, but this evil was being remedied as rapidly as possible. Marriage itself was a most delicate subject, and, being a bachelor himself, he would not touch much upon it. It had been said that the army should be so regarded that a man ought to consider it the greatest grievance to be turned out, but could they ever expect such a state of things to exist? He believed not, unless they went the length of paying something like four or five times the amount which was paid at present. If a man, an artisan, in full work could get from 5s. 6d. to 6s. a-day, when a soldier only got 1s. a-day, how could they expect the position to be so much looked after? The great point they had to consider was the two systems of army management, that of a regular army, and that of a volunteer or temporary army. The advantages of a regular army were that the men were always drilled to it—they all knew that one of the greatest improvements in manufactures was that of putting every man to that particular work which he was fitted for—but the principle proposed by Mr. Cole appeared diametrically opposed to that; he assumed that every man should attempt to be a soldier, and Prussia was brought forward as an instance of success in that particular direction, but he believed it was recognised as a fact, by the highest authorities, that had the Prussian war been continued for another year the whole country would have been bankrupt, owing to the system which existed in regard to the army and navy having almost put a stop to trade and the ordinary business of life. If that was really the state of affairs in Prussia, he would leave any one to judge what it would be in a country like ours. He represented a large northern constituency, where a great number of people were employed, and he knew the answer he should get from them at the hustings if he were to propose that all males between 16 and 26 should be taken away for a certain period to learn drill. It might be economy in one sense that the army estimates

should be reduced for the year, but it was a question whether, on the other hand, there would not be greater loss upon the community. This was the point on which he should have liked to have heard more discussion. It was said that a soldier could be made within a short time, but there were doubts with respect to that. The experience of Garibaldi and his volunteers showed that they answered very well as long as they were fighting against men who were not soldiers, but the instant they came to fight against the Austrians, they could not even make a breach in the Austrian front. They did very well for skirmishing on the mountains, but Garibaldi never himself dreamt of such a piece of folly as to put them in front of regular troops. Then, again, came the Americans. They were very quick, and might be expected to bring men to perfection as soon as any one, and no doubt, at the close of the war, they brought out as fine an army as could well be seen in many respects, but the first time they were in action was at Fort Sumpter. Having blazed away for a long time the fort surrendered, and the only man killed in the whole action was one who lost his life through the fireworks when the fight was over. Two English regiments would have walked right through the whole country, at the beginning of the war, before the men were trained. They must not, therefore, too lightly or easily throw on one side any system which was found to work well. No doubt there were one or two points which required modification. He believed that the three services were far too much separated; he should like to see them brought under one head; then, under such a scheme, the army would be rendered as efficient as possible, and possibly reduced in number, but nothing should be done to affect the efficiency of that number; and then there would be a nucleus round which all the valour of the people might cluster in time of need. In the next place, with regard to the militia, he believed they might be made a very efficient second body of reserve; and, lastly, he should like to see—what would come very nearly to Mr. Cole's suggestion—the volunteers put on a more satisfactory footing. He should like to see the Government take them a little more in hand and increase the capitation grant, and although it might cost the country a little more it would be money wisely laid out, because there might follow a much greater decrease in the regular army itself. As far as he could see, the volunteers had behaved honourably and patriotically, and deserved every possible encouragement. The system he would suggest would be that the man should give his time, at any rate for a certain period, for drilling and training, and should engage at a proper time to subject himself to military law if required. When that was done, every other expense should be borne by the country. He believed a compromise of that kind would tend very much to increase the efficiency of the defences of the country.

Mr. SPENCER WALPOLE said it appeared to him that although they must leave to military men the task of organising the army, still there was a preliminary process of converting civilians into soldiers which might fairly be considered open to general discussion. He would not go into details which had been discussed by other gentlemen, but, according to the wish of Mr. Cole, confine himself to the main characteristics of the scheme proposed, which seemed to be the formation of a very small standing army, and, coupled with that, the liability of a large proportion of the adult male population to serve their country in case of need. He thought the time would have been more usefully occupied if these two points had been more prominent in the discussion. He had a few objections to make under each of these heads, and, in the first place, he thought Mr. Cole had enormously under-rated the requirements of the country in the way of a standing army. He would leave to others to decide the question whether our great colonies should be left to defend themselves, but, at any rate, it was worth reflection that the army which Mr. Cole

proposed would be barely sufficient to maintain our Mediterranean garrisons, and it appeared to him to need no demonstration that if England was to maintain her commercial supremacy, which was almost identical with her maritime supremacy, we must maintain in different parts of the world garrisons to protect our different coaling stations. He was aware that Mr. Cole excluded India altogether from his calculations, but the number he proposed was barely sufficient for Gibraltar and Malta.

Mr. COLE begged to explain that he proposed to keep a standing model army always in England, and that the additional numbers of artillery, engineers, and the like, which he proposed should be always kept up, should be employed in the colonies, such as New Zealand, &c. He had provided for the colonial garrisons nearly on the same scale as at present. It might be a question for discussion whether he had sufficiently provided for these matters, but he had certainly not overlooked them as Mr. Walpole seemed to imagine.

Mr. WALPOLE believed all military men would be of opinion that these scientific corps must be supplemented by ordinary troops in large garrisons. The £30,000 which Mr. Cole had provided for the colonial corps was about the sum now spent in colonial corps strictly so called, such as the gun Lascars and native troops in India.

Mr. COLE remarked that his idea was that the colonies should be in immediate communication with England, so that troops could be sent them by steamships directly they were required; and in all these places, including Gibraltar and Malta, he always proposed to keep a force of artillery and engineers.

Mr. WALPOLE had no wish to argue the matter, but was quite content to leave it to the sense of the meeting whether or no it was desirable to have standing garrisons in these colonies. Passing to the second point, that one-thirtieth of the population should be liable to military service in case of need, he would observe in the first place that he had no objection whatever to drilling the population; he had been a volunteer himself and knew the benefit of it, but if one-thirtieth of the population were liable to serve as soldiers when required, there was an end of the voluntary system, and it became compulsory. It must come logically to that. If the Government had not the power of calling out these troops, where was the reserve, and if they had, it was compulsory military service, which he objected to, as being only another name for conscription, and he believed the system of conscription was not only bad economically, but opposed to all the principles of free government. If they preferred to pay to keep up a standing army, which he believed the great majority of the people would, why should they be asked to disband that army, and make themselves all liable to military service? He preferred paying another man to do the work which Mr. Cole wanted him to do for himself. He believed it had been a maxim of every political economist, from Adam Smith downwards, that it was cheaper to pay another man to guard your house than to do it yourself. If Mr. Cole's views were sound, we ought, on the same principle, to disband the police, and defend ourselves in every possible way. Of course it was suggested that those who did not like to serve might pay a substitute; but there would be many who might strongly object to military service who could not afford to provide substitutes. There might be two workmen, one earning 40s. and the other 10s. a week; the recruiting sergeant did not go to the 40s. man, because he knew there was no inducement for him to take the shilling; but the moment compulsory service was introduced, there would be no distinction between the well-paid workman and the common labourer; and in proportion as the intelligent artisan was taken, instead of the uneducated peasant, so the productive power of the country would be reduced. The only proper stand-point from which to view this question was what position would they be in in case war broke

out. Mr. Cole's scheme might do very well in time of peace, but he did not think sufficient provision was made for the enormous strain which would be put upon us in time of need.

SIR CHARLES TREVELYAN said he had obtained the permission of the Chairman to speak for a few minutes on one special point which had been alluded to by Dr. Stallard, that of marriage in the army. That gentleman had expressed his opinion that marriage was incompatible with efficiency of military service, and also highly detrimental to the moral character of the women and children thus brought into connection with the army, and there could be no doubt that he was right to a great extent. He had considered carefully what were the motives which led to marriage in civil life, and he felt certain that the animal instincts had much less to do with it than was generally supposed. The most prominent feeling in a young man just entering upon life was that of curiosity to see the world and the ways of the world, but after a time this desire became satisfied or blunted, and a new feeling came over him, which, he believed, was, in most cases, the motive for marriage, namely, a desire to be settled, and have a home of his own. He would not attempt to analyse it further, but it was closely connected with the affections, which crave for appropriate exercise after the novelty and excitement of youth are over. He believed this was the experience through which male humanity ordinarily passed, the first stage being longer or shorter according to the disposition of different individuals, but generally lasting about five years. Now, according to the scheme of a popular army, the great majority of men would serve for one year only, after which they would return to civil life; and of course there would be no hardship in prohibiting these men from marrying, even if they had the wish, which, in the great majority of cases, they would not have. If they married in spite of the prohibition, they should be dismissed. Then, for the regular army, he advocated a seven years' term of service, and even that was not at all incompatible with abstinence from marriage. If a man entered the army at the age of eighteen, his term would expire at twenty-five, which was just about the time when, if his (Sir C. Trevelyan's) theory were correct, he would begin to think of settling, and there would be nothing whatever to prevent his forming a marriage engagement in the last year or so of his service, which would have a beneficial moral influence upon him. There only remained, then, the class of twelve years' men, who he proposed should act as instructors of the rest, and in their case he saw no objection to marriage; on the contrary, the position which they held in the army would be strengthened by their being married men.

Captain WAKE, R.N., said he had only a few remarks to offer, and they would be principally on the necessity of making some provision for emergencies. Nobody could suppose that it was left to our own option whether we should be prepared for defence or not. Even Exeter Hall agreed that perilous times were coming upon us, and there could be no doubt that we ought to be prepared in the best possible manner. The first and most important step towards the organisation of a national army was, in his opinion, to obtain a faithful record of all the men in the country, and allot each man his own proper position in the event of danger. There was an enormous army of roughs and paupers in the country who would be of the greatest service in the event of a sudden breaking out of war, provided they each had a station allotted them where they could put themselves under the direction of an officer appointed for the purpose. They did not want every one to be a soldier at once, but they did require that every man should know where his post was in case of danger. It was all very well to talk of ironclads, but he had not so much confidence in our naval supremacy as at the time when wooden ships alone were in use, for the simple reason that wood would float whilst iron would not, and they never knew when

an ironclad would go to the bottom. He did not, therefore, think that the system of defence would be complete without a national army, and the first step towards that would be to enrol every man, and allot his position, where he would be placed under the control of somebody who would instruct him in his duties. When this was done, the further organisation of the system might be left in the hands of regular military authorities.

The discussion was then adjourned to Monday, March 1st, at 11 a.m.

#### CANTOR LECTURES.

The fourth and concluding lecture of the course by Mr. S. A. Hart, R.A., "On Painting," was delivered on Monday evening, the 22nd inst., the subject being "Landscape Painting." An outline of these lectures will appear in the *Journal* at an early opportunity.

#### TWELFTH ORDINARY MEETING.

Wednesday, February 24th, 1869; THOMAS BAZLEY, Esq., M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Cluff, William, Grosvenor-house, Hoe-street, Walthamstow, N.E.  
Dickens, Thomas, Middleton, near Manchester.  
Harriss, J. Fordham, 7, Twickenham-park, Middlesex.  
Hewson, Henry, 2, Brighton-villas, Twickenham.  
Hogarth, George, The Elms, Foot's Cray, Kent.  
Jacomb, Arnold, 70, Jermyn-street, St. James, S.W.  
Matthews, James, 26, Wimpole-street, W.  
Paice, Bowes A., 9, George-street, Hanover-square, W.  
Tulk, John Augustus, Dunster-lodge, Spring-grove, Isleworth, W.  
Whitley, John R., Railway Brass Works, Bowman-lane, Leeds.

The following candidates were balloted for, and duly elected members of the Society:—

Birkett, Frederick Blow, Hampton-court, W.  
Brandreth, Edward, 1, Elvaston-place, Queen's-gate, W.  
Daubeney, Colonel, C.B., Osterley-lodge, Spring-grove, Isleworth, W.  
Despard, Frederick, West-hill, Highgate, N.  
Hughes, Samuel, C.E., F.G.S., 14, Park-street, Westminster, S.W.  
Lermite, Edwin, Muswell-hill, N.  
Lloyd, Edward, The Winns, Walthamstow, N.E.  
Trevelyan, Sir Charles E., K.C.B., 8, Grosvenor-crescent, S.W.  
Wright, Henry W., 3, Keith-terrace, Uxbridge-road, Shepherd's Bush, W.

The Paper read was—

#### ON VENTILATION.

By DR. EDWARD SMITH, F.R.S.

##### PART I.—GENERAL PRINCIPLES.

I am quite aware that there are many persons who seek to increase and to spread knowledge on the subject of this paper, whilst there are others who know nothing about it, and who care nothing, so long as they are not interfered with, and others still who regard it as a fashionable folly of the day, but a necessary evil. There are not a few who attach sufficient importance to it to invent a method of ventilation; and I fear that it may be said that there are nearly as many views on the subject as there are advocates of it, so that, in the dis-

cussion of this evening, we shall, doubtless, be all of one mind !

It cannot be denied that, of late years, increased attention has been given to the ventilation of public buildings, and that improvements have really been effected ; but the subject is still novel, and in both its theory and practice calls for more accurate and extended information than we possess. We might, therefore, to-night profitably consider any of the several divisions of the subject, such as the abstract principles involved in the movement of the air, the ills which follow deficiency or excess of ventilation, the numerous methods by which architects and others are groping their way with much blundering to a satisfactory result, or specific directions as to the ventilation of each kind of public and private building.

My own experience, official and otherwise, leads me to think that a discussion of a practical nature upon two of these divisions would be the most useful at the present time, but as they are too extensive for one paper, I purpose to consider only one of them to-night. Those persons who ventilate our public buildings have, I think, a tolerably correct opinion on some of the more obvious principles of the science, but they fail in not duly weighing the limitation of those principles in practice, and thus fall into error. Hence I think it will be useful to attempt to correct these errors, by considering, in a brief manner, some of the principles involved in the science of ventilation, with the methods at present in use, and the conclusions at which I have arrived. The second part, to which I have referred, is the practical consideration of the existing modes of ventilating our private and public buildings, and the plans of construction which are required for different classes of buildings, in order to render them healthy and fitted for their purpose ; and this must be deferred to another occasion.

The essential part of ventilation is movement of the air from a particular place. It follows that when a portion of air has been removed from a part of a room another portion will rush in, and, although it is usually implied that the removed air is less pure than the new supply, this is not a necessary consequence ; since ventilation is required even in the open-air, and in masses of air of equal purity. No ventilation can be effected without movement of the air, but with the movement other actions follow ; and so important are they that movement may be beneficial even when the new supply shall be less pure than the removed air. The regulation of the movement of the air is, therefore, the basis of the practice of ventilation, whilst the character of the new supply is an element which demands careful attention.

The necessity for movement of the air is based upon the requirements of the body and the constitution of a mass of air. The body must rid itself of heat and moisture, and of certain noxious and offensive products ; the two first chiefly by the skin, the third chiefly by the lungs, and the fourth by various organs. As to heat, the body is warmed chiefly from within by the changes which the food undergoes ; and as, notwithstanding any excess in the supply of heat, it is maintained at about an uniform temperature, it follows that it must rid itself of superfluous heat by discharging it into the air. Air is, however, a bad conductor of heat, and when the excess of heat is considerable, the layer of air about the body cannot remove it with sufficient rapidity, but in proportion to the rapidity of the movement (other things being equal) will the heat be more or less rapidly dissipated. What lady has not proved this by her fan ? And in hot weather, or in a hot climate, how delightful it is to hold up the naked hand even, much more to expose a large part of the body to the punkah or the breeze. This, it will be observed, is not a question of air at different temperatures, but with air at the same temperature ; we may feel hot when the air is stagnant, and cool when it is in rapid motion. Yet, in certain conditions, and in a degree, cooling of the body may be attended with cooling of the air, for it is chiefly effected by the sudden conversion of the fluids of the body into vapour

by perspiration and respiration, from which an immense amount of heat becomes latent, viz., loses its sensible effect upon the thermometer, for the latent heat of vapour is about 1,000 times greater than that of fluid. The abstraction of this heat occurs near the surface of the body, and the air in contact with the body and the body itself may become cooler. Hence the body is cooled both by contact with the air, or by transmission of heat, and by evaporation of fluid, or the absorption of heat, and for both processes movement of the air is necessary. The moisture which is emitted from the body is absorbed by the air, but the capacity of the air to absorb moisture is limited, and at a low temperature is soon exhausted. Hence, as one layer of air loses its capacity, there is need for movement to bring a new supply.

But besides these two operations, the sense of comfort and the state of the spirits, and thence of the health, require movement of the air. You enter a large room which has been shut up for a long time, and with a sniff of the air you remark its want of freshness. If you stay in it you feel low spirited and unhappy, and yawning, with or without headache, will follow ; but introduce a punkah, or adopt any mode by which the air is set in motion, and some sense of relief will follow.

So much for the body. But the air itself, in order to keep it somewhat uniform in character and fitted to maintain health, must be in motion.

A closed house is generally a damp house. The lower stratum of the atmosphere holds more moisture than the higher. The air surrounding living bodies receives contamination, as it also generally does when in contact with the works of man ; and the sewage system and the gas light system of our day do not a little to foul the atmosphere. But this applies to a limited portion of the atmosphere, and when the air is in motion other portions not thus tainted are supplied, whilst the contaminating matters become less and less noxious or disagreeable as they mix with the larger volume of purer air, until they are no longer perceptible or efficient for evil. This applies not only to spaces enclosed by four walls, but in some degree to our courts and alleys and even to our streets and towns, for it has been shown by Dr. Angus Smith, Professor Roscoe, and others, that such places, being confined, have the air more contaminated than that in the open fields, or on the top of a mountain. Hence we need ventilation to drive the air of rooms into the courts, of the courts into streets, and of the streets into the country, and to draw to us the air the good qualities of which our country friends do not always fully appreciate.

Movement of the air is of two kinds ; one always quiet, by the interchange of gases, a physical property which is essential to air and all gaseous fluids by which gases of different kinds mix together, and if enclosed acquire one composition. A whiff of tobacco-smoke, or a jet of vapour of eau de Cologne may be seen or smelt for a moment in a certain spot only, but in a short time, as we know, it extends and impregnates the whole air within certain limits. This is constant, continuous, and without observation, and is of the utmost value in ventilation. It moreover acts in all directions, and is limited only by the amount of the matter to be distributed, and by the enclosure of the whole volume of air. Without this influence the exposure of the body to foul and noxious agents would render life miserable, and in the end would destroy it. How soon would the bed-head, for example, be a reservoir of deadly gases.

The second kind of movement is due to influences acting from without, a body of air. The winds are the great ventilating agents, and their influence penetrates wherever the external air can gain access, but their influence varies with their force and direction, and the obstacles which walls and other impediments offer to the movement of air. Their action must be the basis of any large system of ventilation, and in my opinion they must, under nearly all circumstances, be the chief agents.

Similar effects, but more limited in degree, follow mechanical contrivances. The punkah in hot climates, is an illustration, but in this climate the movement of persons in a given space is the most frequent agent, and when we limit our observation to a room, the movement of persons through it and within it, is not by any means without effect. The currents which occur with open doors and windows are due to the movement of the external air in so far as they result from this mechanical action only, for narrowing an aperture in a stagnant room does not produce a current as it would were the air in motion.

The third important cause of motion is that of heat. Air expands 1-480th of its bulk for every degree of heat, Fahr., above 32°, and, consequently, if we take an ordinary-sized room (say 20ft. long by 12ft. wide, and 10ft. high) there would be an expansion of 5ft. for each additional degree of heat, or a practical loss of 60ft., equal to a layer 3in. deep over the whole room, with an increase of 12 degrees of heat. This would be equal to lowering the height of the room from 10ft. to 9½ft.—assuming, of course, that no fresh air at the lower temperature were admitted. An essential condition of this change is that the heated air ascends, since it is lighter, and there are currents moving upwards, whilst, at the same time, the air which is colder descends and causes descending and lateral waves or currents until the whole mass has attained a uniform degree of temperature. Every person, and every light in a room, is a cause of these currents, and the room in which we are now assembled is full of them. As the total volume of air increases it follows that some must escape (unless we assume the room to be air-tight, when, with expansion of the air from heat, there will be condensation from pressure), and this will occur at the top of the room if there be openings, or at the sides, or even at the bottom if there be no other mode of escape. When the air becomes cooler it condenses in volume, and more air is admitted by descending or lateral currents into the room.

With elevation of temperature certain other conditions occur, which have great importance.

The power to cool the body by contact is lessened.

The air is capable of absorbing a larger amount of moisture, and is relatively drier, until the increased quantity has been supplied.

The skin is rendered more sensitive to cold, and the tendency to perspiration, by which the heat of the body is removed, is increased.

Above a certain degree there is a tendency to exhaustion of nervous power and relaxation of tissues which render an individual less capable of mental and bodily labour; lassitude, low spirits, headache, and indisposition to make any effort, are well-known results of occupying a close and hot room.

## PART II.—MODES OF VENTILATION.

Such is a short reference to some of the more evident and important principles involved, and I now proceed to offer a few observations on existing methods of ventilation. The ordinary method even at this moment is simply by windows, doors, and fireplaces, and the variation in amount of ventilation is due to the degree in which these are opened. The objections to this plan are:—

1. The attention of some person is required to regulate the openings according to the degree of ventilation required; and as this cannot be the chief duty of a particular person, whether in a private or a public building, and it would not be easy to find a person for the duty with sufficient knowledge and judgment, the result is either too little or too much ventilation.

2. In the summer time, when ventilation is required but fire is not wanted, it is very usual to close up the chimnies, and particularly those of bedrooms. In cold weather and at night all doors and windows are closed, and they act as ventilators only in the degree in which they are ill-fitting, whilst ventilation is particularly required in bedrooms at night, and the use of gas in the

long winter evenings calls for good ventilation in sitting-rooms.

Such an arrangement cannot be otherwise than defective, yet it has not been objected to even in some hospitals, for during a late discussion on this subject it was gravely affirmed that the ventilation in workhouses must be defective, because workhouse nurses were said to be less reliable than those of a particular hospital in reference to the opening and closing of the windows.

Many devices have been adopted with a view to ventilate by windows. Some have the double hung sashes by which air may be admitted at the highest and lowest parts, and in a degree in the middle also, in such proportion as may be desired, and this is, I believe, the best construction at present known, provided the window extend so near to the ceiling that, when the upper sash is drawn down but a little, the entering air may be so far above the bed, or above the head of the inmates, that the current may not be injurious. It is, therefore, inapplicable as the sole means of daily ventilation to low rooms, viz., to rooms less than ten feet in height. Some windows have the upper portion to fall inwards, with a view to direct the current of air upwards, and it is held in that position by a cord, or by falling into a hopper with the sides of the V-shaped space closed or open. Such a ventilator admits too large a volume of air in one place in cold weather, and in order that it may be safely used the room must be of great height, as, for example, 14 feet and upwards, but even then it causes discomfort, since the current of cold air eventually falls, and the room becomes cold, unless other means of warmth are provided than open fireplaces. I have, however, seen this plan in operation in windows within three feet of the head of the sleeper, but in such places the natural remedy, was applied, viz., to shut them, except when kept open in the presence of superior authority. Others have the lower half of the window to fall forward into a hopper, and the evils just mentioned are intensified; whilst a more modern, but scarcely better, invention divides the window into four or more parts, each or all of which may be opened at pleasure, and fails for the like reason.

A very frequent contrivance in the old iron window frames is to provide a special portion in the centre or upper part of the window which may be opened inwards, outwards, or laterally, or fall inwards into a hopper. Such openings are always placed too far below the ceiling, but the quantity of air admitted in one place is smaller than where the opening extends across the whole sash, and they are only so far less injurious. The old lattice window, which opens by hinges on its side, is in like manner unfitted for the purpose of ventilation, except in conditions where a large volume of air could be admitted without injury.

These evils having been appreciated, ventilation has been effected by placing perforated zinc or perforated glass panes in some parts of the windows: or a strip of perforated zinc has been placed across the top of the window-frame, to act when the upper sash is drawn down, and where the windows have been high, and the ventilating panes have occupied the highest elevation, the plan has been very valuable, but the principle is that of a ventilator, and not of a window, and will be again referred to.

Ventilators, properly so called, are found in great variety. Some are placed in the ceiling, and communicate with the room by openings of various forms and sizes, and with the external air by external gratings, with or without special channels, or simply by the accidental openings in the roof. The principle involved in their use is that the foul air ascends, and should leave the room at the top, whilst fresh air enters at the bottom. The term foulness of air is often another expression for simply heated air. If the heat be generated within the room, whether by gas or living beings, the air will be both heated and foul, but when generated by fire in a proper stove or firegrate, or by hot-water pipes, the air may be heated, but is not foul. But



assuming that the air is both heated and vitiated, it does not follow that the foul air will ascend to the top of the room, since certain noxious matters, as carbonic acid (the chief product of respiration), are heavier than air, and with a still atmosphere, and the source of vitiation at the height of a man or of a bed only, will, in a degree, tend to accumulate in the lower part of the room. The principle is, undoubtedly, correct in reference to the products of gas-burning and to crowded rooms, where the generated heat and foul air are considerable, but for ordinary bed-rooms at night, without gas or fire, and with few persons sleeping in a room, it is not applicable. In such conditions it is true that heat is generated, and that heated air ascends, but as the increase in the quantity of heat is not great, and as the ascending current of the heated air meets air which has not been heated it gives out a portion or the whole of the excess, and further ascent is retarded or prevented. The higher the room, and the less the degree of heat generated, the weaker will be the ascending current, and the less the quantity of air which will pass out by ventilators in the ceiling; whilst, on the contrary, the greater the supply of heat, and the lower the room, the stronger will be the ascending current, and the greater the quantity of air which will escape. Hence its operation is not equal and universal; and, from the above statement, it will be seen that it is always insufficient to remove the heat, unless conjoined with a system of openings in the lower part of the room, that is to say, where the foul air is generated.

Further, it is not an universal proposition that air will be admitted below and escape above. With little increase of heat, it will be admitted both above and below, and with much increase of heat it will escape both above and below, although in greater amount above than below. Some of the openings so placed in the ceiling or roof communicate with the external air by a tube, defended on the outside by a cowl or other contrivance. The rapidity of the current, whether directed outwards or inwards, will depend upon the size of the tube, the difference of temperature of the internal and external air, and the force of the wind, but where the tube is large, and the generation of heat is not great, the current is usually inwards. Some such ventilators have the tube divided by a perpendicular diaphragm, which, in fact, makes the one tube into two; and it is stated that the air ascends by one and descends by the other. Whether it will ascend by either depends upon the amount of heat generated within the room, but even where the latter is very great, and there is a strong current upwards, it will be found that there is an ascending and descending current in both tubes—currents not of equal force or volume, but varying with the admission of air by other openings, as I observed when instituting inquiries into the sanitary state of printing-houses and workshops for the Privy Council.

The fallacy which lies at the root of these statements is in ignoring the fact that inhabited rooms are not boxes hermetically sealed, or having only one opening for the admission of air, ignoring the existence of doors and windows, which even when closed allow a certain quantity of air to pass. If the room were a box, closed, except at the ventilator, it would follow that if air passed out it would also pass in by the opening; and it may be that under certain conditions of temperature the air would rise in one tube and fall in another, but such rooms do not exist. The most frequent approach to this condition is where there are two fire-places in one room, in one of which a fire is burning, and the doors and windows fit well and are shut, for in such a case there may be a down draught in the chimney without a fire. But even this is not universal, for with the tendency to rarefaction of the air which occurs by reason of the heated air passing up the chimney, the hand placed at the sides of the door or window will perceive an unusual rush of air inwards to prevent a vacuum, and thus prevent the necessity for a down draught. Moreover,

where there is only one chimney, and the doors and windows fit closely, the fire languishes, and the more so the longer the doors and windows remain shut from the rarefaction or loss of air which the heat induces. Open the door or window, and the fire will brighten, and the sense of oppression felt by the inmate will pass away.

In practice it will be best to consider that air will both enter and leave by openings communicating with the external air wherever placed, and with the ordinary construction of doors and windows if air be removed at any height the deficiency will be immediately supplied; but, in order that heated air may be quickly removed, it is essential that there should be openings at the upper part of the room.

Other ventilators are placed in the upper part of the side walls, and are either entirely open or defended in some manner. Such are air bricks, or yet larger openings, and, when not defended, they will admit air in proportion to the size of the opening, and the force and direction of the wind. When not defended it is scarcely possible that the current of air will not be felt by the inmates, and where much heat is generated, and the current sets upwards and outwards, it may be felt as injuriously as when the current is from without and downwards. Hence some defence is needful, and if none be provided the inmates will, if possible, extemporise one by the aid of rags, clothing, or bricks. The defences are:—

1. Perforated zinc of varying degrees of fineness of perforation—the finer, the more is the current divided and the less it is felt, whilst, at the same time, the greater is the impediment offered to the admission of air, and the less air is admitted in a given time.

2. A solid, but movable barrier, which may be drawn away laterally or vertically, or allowed to fall forward into a kind of hopper, or the ordinary glass or wooden louvre ventilators. Such may be entirely closed, and then they are no longer ventilators, and when the hopper is open not only is the current directed upwards, but the entrance of air is impeded. Hence, when open, the value of these ventilators varies with the quantity of air which they admit in a given time, and their fitness depends upon their sufficiency, and upon the sensation which the inmates have of the existence of a current.

3. A fixed barrier to the direct entrance of air, placed at a little distance from the external or internal opening. This is sometimes so effective as to nearly destroy the value of the ventilator by preventing the entrance of air.

4. Different elevations of the external and internal openings, by which the entering current strikes the wall, or the side of the tube, before it is admitted into the room, and its force is broken. The efficiency of this depends upon the length of the tube and the force of the wind.

A third series of ventilators act by mechanical means, or by an arrangement for the production of heat, and consist of tubes, of various forms, which communicate with the rooms and the external air.

The Archimedean screw is an example of the former, and, being placed at the top of a flue, is moved by a vane acted upon by the wind. It has been proved that a screw, moved in this manner, carries up a column of air as it would a column of water; but it is dependent for its action upon the wind, and when winds are light, as in summer, and circulation of air is specially required, it fails. When in action its efficiency depends upon the length and diameter of the tube, in relation to its own power, and it is more efficient in the upper than in the lower rooms of a lofty house. It must also be added, that the tube will act as a ventilator, like other tubes, without the screw, and will admit or give exit to air on the principle already laid down.

Special openings into the chimney, as by Arnott's and Toynbee's ventilators—the former of which is liable to allow the smoke to escape—and flues passing by the side of chimneys, are examples of the second series, since



their special action as ventilators is due to the warmth of the chimney, by which an ascending current of air is induced. Such flues act in proportion to the temperature of the air within them, and therefore to the heat of the chimney, their proximity to the chimney, their length, and the volume of air which they contain; and it is clear that neither ventilation into chimneys, nor flues placed by the side of a chimney, can produce an upward current where there is not a fire burning, or where the chimney or special flue is not heated. This is very frequently forgotten by architects, and as fires are not commonly made in bedrooms at any season, nor in any rooms in the summer-time, they fail to produce an ascending current. Yet they may not be entirely useless, since air will usually descend by them when it cannot ascend, and they supply air to the room; and as the special flues are less dirty than chimney flues, the air they admit may not be disagreeable to the senses.

To remedy this defect, a jet of gas is sometimes placed within the flue or a reservoir of hot water, or a fire is placed near the upper part of the flue with a view to produce and maintain an ascending current of air. The efficiency of all these methods depends upon the amount of heat applied in relation to the width and height of the flue, and it must not be assumed that because there is a single jet of gas in some part of the flue an ascending current will be always maintained. The efficiency must be tested by experiment. The openings of such flues are sometimes placed at the ceiling either with one grating or with several, more or less concealed in the cornice which extends around the room; or they are placed at different elevations in the side walls, or on the central line of the floor of the room. One of the more recent inventions of this class is the ventilating gas burner, by which fresh air may be admitted from without, and consumed air emitted by the chimney; but the state of the ceiling shows that, in some instances at least, the whole of the foul air is not removed, and it is too costly for universal use. Another is the ventilating stove by which fresh air may be admitted from without, and warm air driven through into the room, and both currents may be regulated. This may be adopted without much increase of cost if the stove be introduced when a stove of some kind is needed. Care should be taken to remove the entrance opening of the warm air so far from the chimney opening that the current may not be directed up the chimney instead of into the room. The forcing or suction pump, or the driving wheel, may also be mentioned; but their use is restricted to large public buildings. They are, however, very effectual in creating a draught, whether by withdrawing or injecting air. All these artificial methods, however, are costly, and nearly all of them are dependent upon conditions which require the aid of man.

### PART III.—CONCLUSIONS.

It now remains for me to state summarily the conclusions to which a consideration of the subject and my official experience have led me.

1. Interchange of air which proceeds both by diffusion and removal is not instantaneous. The rapidity of the interchange varies with many circumstances.

2. The effects of any natural system of ventilation vary with the season as well as with the special conditions of a building and the number of inmates.

3. There is a relation between ventilation and temperature, which in reference to inhabited rooms is generally an inverse one, and as the human body requires a temperature of the air of from 55° to 65°, according to the season, ventilation in cold weather must be restricted by the lower, and in hot weather by the higher temperature.

4. The movement of the air, although so essential to health, must not be very perceptible lest it should cause discomfort and disease. Hence the inlets and outlets must not be very near to the inmates, and the current must be divided.

5. The ventilation should, if possible, be self-acting after the amount required in a given room and under given conditions has been fixed.

6. Any general rule which may be laid down as to the number and size of the ventilators required in a room will demand modification by experience, since the admission of air will depend upon the elevation of the site, the direction of the prevalent winds, and the impediments which surrounding walls and buildings offer, and these cannot be the same on all sides of a building.

7. Some differences in the plan, and much in the extent to which the plan should be carried, must depend upon the use of the rooms and the destination of the building, as to whether it be a private house, a public building with a fixed number of occupants, or a building, as a theatre, with a very varying number.

8. There is a relation between space and ventilation, for it is evident that with defective ventilation (not entire absence of ventilation) the larger the quantity of air in relation to the number of occupants the less the immediate evil, whilst at the same time, the larger the mass of air to be moved the greater is the force, or the more extended are the means, required to move it. In private houses the cost is often unimportant, but in general, and particularly in reference to work-houses, hospitals, and other charities supported by voluntary contributions, the aim should be, by providing the best ventilation, to reduce space to the strict requirements of the occupants, and thus to utilise in the greatest degree the money to be expended. That relation must be determined by experiment. Both architects and amateurs are apt to give undue weight to the lofty, spacious, and handsome appearance of their buildings, and too little to the solution of the problem of fitness with economy.

9. The test cannot be the life or death of the inmates, for health may be failing long before it ceases. Moreover, there are various degrees of health, and each person has a separate aspect of health, and it is not at all easy to indicate in particular cases the first period when some injury may have been done to it. A test is required by which we may infer that injury would result if the cause were continued, and this must clearly be derived from observation. A close-smelling or a foul-smelling room may not be immediately injurious to health, but it is disagreeable at the least, and as such should not be allowed; and although the most injurious emanations from the body are not offensive to the smell, their emission is accompanied by the emission of offensive odours, and the two will co-exist. There is thus a relation between them which may be made useful as a test, so that if in an inhabited room the air be foul to the sense of smell it may be regarded as injurious to health. But the degree of relationship is not exact, since an uncleanly person, or even a cleanly one, having the peculiarity of emitting strong odours in an unusual degree, will cause the air to be foul almost as soon as he enters, whilst another cleanly person may stay some time in the same room before rendering it offensive. Hence, in making the estimate, we must strive to ascertain whether the foul smell proceeds from dirty clothes, and particularly dirty stockings and unwashed skins, or is simply that which occurs with cleanly persons. When there is no offensive smell it may be assumed that the ventilation is sufficient; but as a certain amount of want of freshness, or closeness, is found in our bedrooms or other rooms without known injury to health, I am of opinion that the ventilation is sufficient when the air, after the night's use, is not more offensive than is found in an ordinary private bedroom of the middle classes. Absolute purity of air in inhabited places, whether rooms, houses, public buildings, courts, streets, or towns, however desirable, is not necessary to health, and is not attainable.

10. The test cannot be the means provided to effect the passage of a given quantity of air through a room in a given time, for if the ventilation depend upon natural

agencies, it will vary with the force and direction of the winds, the impediments to their action upon a particular ventilator, the frequency with which doors are opened, and other varying causes. If the room were closed, except at particular places, and the air were, by artificial means, conveyed through apertures at a known rate, it would be possible. We do not, however, live in closed boxes, and we cannot separate ourselves from the influence of natural causes.

11. Where persons do not occupy the same room or rooms throughout the 24 hours, but use other rooms, and particularly spend much time in the open air, defective ventilation of those rooms will be less injurious in proportion as they are used for a shorter period of time.

12. The cost of ventilating buildings is usually of importance. None can be so little as that mode which introduces the external air directly, but with proper safeguards, whilst all artificial systems are expensive.

13. No system can be efficient, in a public institution, which depends upon windows, doors, and fire-places alone; but, for thoroughly renewing the air on fitting occasions, it is desirable that there be windows on both sides of a room, and particularly in public buildings.

14. When air is introduced on one side of a room only, whether by windows or by ventilators, the extent of its influence will vary with the conditions already named, but there is a relation also between it and the width of the room in reference to satisfactory ventilation. It is evident that, with little force of wind, the air will penetrate into the room but little, and with greater force the more; and also that, with a given force of current, the narrower the room the more certainly will it traverse it, and the wider the more certainly will it not traverse it. Hence, with such an arrangement, a wide room will be less perfectly ventilated than a narrow one, and a point may be readily reached at which the influence of such means of ventilation will be *nil*. Rooms with windows or ventilators on one side only should be very narrow, and still more so if there be no ventilation apart from the windows. A wide room, with windows only on one side, and no special ventilators which act permanently, must be ill-ventilated and unhealthy, as has been shown in the Nightingale Ward of King's College Hospital.

15. When air is introduced on two opposite sides of a room by windows or special ventilators, the current will usually extend further than twice the length of the current from one side of a room, and, as the wind will usually act upon one or the other side, the current will have greater force than with air openings on one side only. But there is a limit to the width of rooms so arranged, for, as the current must not be too great to be borne by those inmates who are placed near the external walls, its power to traverse the inner space is restricted. In very wide wards the ventilation in the middle is not so satisfactory as that near the external walls.

16. Where air is introduced into the centre of the floor of the room a current is produced in the part over which the inmates pass and repass, and is, therefore, very perceptible. Cold air in considerable quantity can rarely be introduced with propriety in that position, but warmed air might be borne.

17. Each room should be so constructed that its ventilation may be independent of that of staircases or any other room, but where two rooms are placed side by side with a partition wall between them, each having windows on one side only, the ventilation of each is improved in proportion as a part of the partition wall is removed. Thus, one room may improve the ventilation of the other, and both be as if they had windows, or ventilators, on both sides.

18. Ventilators should be placed on opposite sides of a room, be of small size, sufficiently numerous to affect all parts of the room, defended on the inside by finely perforated zinc, and be placed at the floor level and ceiling level.

19. Ventilators in a small part of a room only are insufficient for ventilation, since when a current of air passes between two openings the greater portion goes in a direct line, and does not greatly mix with the air lying on either side of it. This may be readily seen when smoke is admitted by an inlet and emitted by an outlet ventilator, or such an arrangement as exists in prison cells.

20. Where the conditions rapidly vary, as in churches, chapels, and theatres, it is impossible to devise a system which will not require modification by an intelligent person. At present the system is universally defective, and only after the heat has become great and the persons very sensitive to cold are the doors or windows opened. The aim should be to regulate the admission of air from the moment when persons enter, so that the temperature shall never be materially increased, but remain at, say 56° in winter, and 62° in summer. Cool air, without draughts, is better borne than hot air with intermittent draughts. In very lofty rooms the apertures for the admission and emission of air should be below the top, not too far removed from the occupants of the seats, the sources of the heat. In addition to this, however, ventilators should be placed in various parts of the ceiling, and be kept under control by a competent person.

21. Such rooms should be thoroughly aired after every occasion of their use, by the full opening of windows. At present, with three services at a church or chapel, this is neglected, and the air is close, heavy, and foul in the afternoon and evening.

22. No artificial means of ventilation should be relied upon solely, which will not act by day and night and throughout the year. Hence with ventilating stoves, which are very valuable, and ventilating air-flues, there should be other and self-acting means of ventilation.

In conclusion, it may be useful that I should sum up the principal errors into which architects are now falling in the systems of ventilation which they recommend. They are:—

1. In not duly estimating the practical limits of the law, that heated air ascends, and the relation of numbers of inmates and size of rooms in the application of the law.

2. In not duly considering that air shafts, acting under that law, cannot act in all seasons, and with and without fire alike.

3. In not duly estimating the amount of air which can be admitted by windows and doors alone.

4. In not duly estimating the practical limits to which an entering current may be carried, whether from one or both sides of a room.

5. In not duly considering the effects of currents upon inmates, and the limitation thus demanded upon the amount, force, and elevation of currents.

6. In not duly estimating the inverse relation of ventilation to temperature in its effect upon inmates, and particularly upon the old and the young.

7. In not duly estimating the influence of the winds, and the impediments of surrounding buildings, &c., upon each aspect of a building.

8. In having incorrect views as to the direction of the current through ventilators at different elevations.

#### DISCUSSION.

Mr. VARLEY opened the discussion by a description of what he called the Society of Arts' ventilator, a prize having been awarded to it in 1843, the main feature being a hollow cornice running round the room with perforations inwards, and also a communication with the external air. He said it had been very successfully applied in a school in Baldwin's-gardens and in various other places. He believed the only true mode of ventilating large public buildings was by reversing the ordinary condition of things, by creating a downward draught, which would draw away all impurities, while the fresh air should be admitted at the top, the apertures through which it entered being so divided and arranged that it should come as a shower rather than in a block or

current. He thought this system would be very applicable to picture galleries, where it was very desirable to avoid dust.

The CHAIRMAN said he had not intended to offer any remarks to the meeting, but it occurred to him that the subject of ventilation was a very important one, particularly with reference to mines, where the lives of many hundreds of human beings often depended on proper ventilation. There was no way of introducing pure air into a room or building without at the same time making provision for the exit of foul air; and if there were only a sufficient number of apertures, he believed the matter would pretty well regulate itself. He recollected an observation of Dr. Reid's, who was employed to ventilate the Houses of Parliament, to the effect that if houses could be constructed something like a sieve, that would be the most complete system of ventilation. This principle of construction, however, had not yet been introduced. Some few years ago he remembered hearing an explanation from the Rt. Hon. William Cowper of the ventilation of the House of Commons, in reply to a series of complaints which had been made of the draughts which caused inconvenience to members. It appeared that in order to test this matter, a number of very delicate films had been suspended in the House, hardly perceptible to ordinary observation, but those who were employed to watch them could hardly discern any movement, plainly showing that the draughts which had been complained of were, in great measure, imaginary. Mr. Cowper also stated that the temperature of the air was carefully regulated, and its purity ensured by being passed through water; if too damp or too cold it was dried and warmed by passing it over hot surfaces, and if too hot it was cooled by being passed through pounded ice, so that on the whole the atmosphere of the House was as equable as was possible in a building which contained sometimes 500 people, and sometimes only 40 or 50. Dr. Edward Smith had opened up a most interesting field for inquiry, and he hoped it would be pursued.

Mr. MEYER remarked, in relation to the ventilation of hospitals, that it was almost impossible to remove all impurities from walls and floors of buildings constantly occupied by sick persons. He therefore advocated the use of smaller temporary iron buildings, which might be erected in gardens, where the vegetation assisted materially in preserving the purity of the atmosphere.

Dr. STALLARD was sorry to say he had not learned much from the paper, which did not contain so much new matter as he had hoped; and several important questions had not been touched at all. They did not yet know so much as they ought as to the real effects of foul air and bad smells; and even the effect of carbonic acid upon the human body was by no means well ascertained. He believed it had been shown that animals could live in an atmosphere containing a very large amount of that gas, provided the mixture of carbonic acid and air were constantly renewed; while, on the other hand, pure oxygen would eventually cause death if the same gas were breathed over and over again, although it might be constantly purified by being deprived of all the carbonic acid which resulted from respiration. Where the oxygen was frequently changed, however, life was sustained. This showed that effectual ventilation did not depend upon the mere removal of carbonic acid. With respect to the practical question of ventilating rooms, he believed they were still much in the dark, and he wished Dr. Edward Smith's paper had thrown a little more light upon the subject. As far as his own experience went, and even taking the results arrived at by the Sanitary Committee for the Army, he thought that in the case of large rooms there had as yet been a failure in all the proposed means of ventilation; at any rate it was plain that small rooms were much more easily ventilated than large ones. With ordinary sized rooms he believed the best system yet proposed was

that of Captain Douglas Galton, but even with that a difficulty arose when the fire was not always in action, and in such cases the room might become very offensive at an early hour in the morning. Ventilators which depended on perforated zinc were exceedingly difficult to keep in order in large towns, for a short time since he had been engaged in an investigation at the Tower, when it was found that a large number of ventilators were quite inoperative owing to the perforated zinc being clogged with dirt and soot. He must protest against the standard of ventilation which Dr. Edward Smith had set up, namely, the ordinary condition of a private bedroom amongst the middle classes; he was continually, as a medical man, going into such rooms, and found, in very many instances, that their condition as to ventilation was disgraceful. With respect to the relation between space and ventilation, he looked upon the former as the most important, and was altogether opposed to the idea of sacrificing space to ventilation. He was aware that it was easier to deal with small bodies of air, but at the same time it was more difficult to prevent draughts and currents, which were felt by the sick with peculiar force. One mode of securing circulation he had lately seen applied, which appeared to possess many advantages, and to be an improvement on the method described by Mr. Varley. There was a double cornice made of zinc, which was, at the same time, cheaper and more ornamental than the ordinary ones of plaster; it was composed of two parts, one being in connection with the chimney or a ventilating shaft specially constructed, and having openings into the room, and the other communicating directly, at various points, with the open air, both being capable of regulation by valves. He was not prepared to say that this plan was altogether satisfactory, but it certainly presented advantages of its own, one of which was the facility with which local currents could be set up in different parts of a room. If cold air were admitted at the bottom of a room it almost inevitably produced a cold current surrounding the feet, whilst its admission at the top had the effect of producing a series of secondary currents, which were very difficult to get rid of; they were even known to occur in a common chimney when the fire was burning. He confessed he was still in the dark as to the best mode of ventilating a large room where a number of people were assembled, and he hoped Dr. Edward Smith's second paper would afford them a little more information on the subject.

Mr. J. C. WILSON thought the paper which had been read left very little unsaid on the matter in a scientific point of view, but he differed from Dr. Edward Smith as to the best mode of warming and ventilating private dwelling-houses. He believed a great mistake was made in limiting the question to that of rooms; they should rather take the house as a whole. In all houses there was one fire almost continually burning, that in the kitchen, and the simple practical question appeared to him to be how best to utilise that so as to warm the fresh air which entered the house below; this air would then pass up the staircase and along the passages, warming and ventilating the various rooms, the foul air escaping at the top of the house. Probably the best mode would be to employ the kitchen fire directly in heating water, which, in turn, would warm the air. If necessary, the kitchen fire might be easily kept in continuously.

Mr. ASHE did not quite understand how the double cornice described by Dr. Stallard would work in the event of there not being a fire. At any rate he hoped that before the second paper on the subject was read all these details would be carefully looked into and explained. He also remarked that in many cases the Arnott ventilators did not answer, or smoked, simply from the want of their being properly proportioned to the size of the chimney, of the opening at the fireplace, and of the outlet at the top. In other cases a plate of sheet iron, placed inside so as to form a kind of syphon

with the ventilator, had proved of great service in preventing the ingress of smoke.

Mr. WALLER said he agreed to a certain extent with the views of Mr. Wilson as to the propriety of warming and ventilating the whole house, but he did not agree that the outlet should be at the top of the house. The Arnott ventilators were best for ordinary rooms, but if the opening to the chimney were too large they would not act properly. If the opening of the ventilator and that of the fireplace were not much larger than the outlet at the top of the chimney, it would generally act well, particularly if air were admitted into the room from an opening in the wall, and not by leaving the door open.

Mr. PHILIP PALMER said that Dr. Edward Smith had found fault with the present method of ventilating churches, but he should be very much obliged to him if he could suggest a better. He believed the difficulty arose from the way in which churches were now built, for, generally speaking, the windows were now nearly on a level with the seats, so that the hoppers or louvres were but very little above the heads of the people, who consequently suffered from the draught when they were opened.

Mr. TRACY believed Mr. Wilson's suggestion of ventilating the whole house from the hall was the correct one. Between architects and speculative builders, he believed the idea of the Chairman, that houses should be built like sieves, was pretty nearly carried out, and, where this was not the case, the houses were not by any means healthy to live in; as an instance of which, he might mention Buckingham Palace. He believed architects looked too much at the outside, instead of considering for what purpose the house was intended, and using every effort to make it comfortable and convenient to live in. Engineers could now tell exactly the proportions requisite in a chimney shaft to a certain sized furnace, and in the same way he thought architects ought to provide for the number and size of the apertures requisite for ventilating every room in a house.

Mr. ROGER SMITH remarked that, as the question of the incapacity of architects had been brought forward, and Buckingham Palace had been mentioned as an instance, it was only fair to mention that the larger portion was built by Mr. Cubitt without the assistance of any architect at all.

Mr. COOPER said, in reference to the suggestion which had been made as to ventilating a whole house from the hall, he might mention his own experience in a coal mine in Wales. The men had a great objection to cold draughts, and liked to be warm and comfortable at their work; and it was found, on the erection in the pit of a donkey engine, which was worked by steam generated at the mouth of the pit for the large pumping engine, the great length of pipe which conveyed the steam to the small engine not only made the air warm and comfortable, but kept up the ventilation throughout the works, which were rather extensive.

Mr. R. RAWLINSON, C.B., did not agree with Dr. Stallard's criticisms on Dr. Edward Smith's paper, which he considered afforded a very good basis for inquiry and discussion. He quite agreed with Dr. Edward Smith that where foul air could be kept in motion it was much less noxious than purer air in a state of stagnation. He had before now been much puzzled to account for the good health of the people who worked in the midst of abominable stench, which were supposed to be highly injurious, and he could only come to the conclusion that in such cases they were obliged to keep the windows and doors open, and thus a constant renewal of the air was kept up, which accounted for the immunity they seemed to enjoy from fevers and other diseases, to which one would have supposed they would have been subject. Air was as much a substance as water, and must be treated in the same manner, namely, if an opening were made for foul air to go out, a corresponding aperture must be

provided for pure air to enter, or no movement would take place, and he must confess that, as a rule, this condition had been overlooked by architects. In modern houses of the better class, also, the builder's and joiner's art was brought to such perfection, every door and window being fitted so admirably, that there was no chance for ventilation at all, no special provision for it being made. It must not be forgotten that the class of houses he was alluding to were destined for a twofold use,—for domestic occupation and for receiving company, but the latter condition was entirely left out of sight in the construction. He did not know of a single house in London where any arrangement was made for extra ventilation on the occasions when the rooms were literally jammed with people. Human beings dreaded cold air much more than impure air, probably from its effects being more immediately appreciable, and as a consequence, wherever there was a visible opening of any kind it was always objected to. In his own house, after suffering a long time from headache, he introduced patent ventilators into the windows, but his wife and daughter never let him rest until they were removed; then Arnott's ventilators were put in all the rooms, but these also were objected to. At last he took off the top of the architrave from the dining and drawing room doors, and having made an opening through the wall, replaced the architrave, having first cut away diagonally a portion of the top so as to leave an opening for the entrance of air above the door, and this being not seen was in time forgotten, and had been found of signal service. His next step was to draw down the staircase window about four inches, and screw it fast, so that it should remain open night and day, and great increase of comfort had followed. In winter the aperture might be lessened to about one inch, and the effect might be further modified by putting a face board in front, so as to direct the current of air upwards. Then, again, water-closets should, in every case, have a fixed means of ventilation freely into the open air, of not less than twelve square inches at the top; this should never be closed, and the arrangements of the seat should provide for its being closed before the handle was drawn up, an aperture in the cover being made for that purpose. Whenever there was a skylight at the top of a house there also should be a fixed means of ventilation. In the case of hospitals a much greater authority than himself, Miss Nightingale, was decidedly in favour of the natural plan of admitting the external air by windows on both sides of the room, modifying the current where necessary by double sashes or screens. This, however, required great cube space, and he did not believe any system of ventilation would make rooms as healthy as they should be when they were constantly occupied by patients, night and day. They wanted some arrangement by which a ward could be periodically entirely emptied, cleansed, and ventilated; and if any system could be devised by which the rooms should be occupied only twelve hours out of the twenty-four, he was satisfied that a great improvement in the health of the inmates would be the result. In the case of the great London hospitals, immense benefits had been derived from the use of carbolic acid (cloths dipped in it being hung up so as to diffuse the vapour), which appeared to have the power of destroying the poisonous organisms or emanations which infected the air of sick rooms, and where it was employed surgical cases could be treated with much greater safety than before. He knew of three large buildings scientifically ventilated, St. George's Hall, Liverpool, the Assize Courts, Manchester, and the Houses of Parliament. St. George's Hall and the Assize Courts were ventilated by Mr. Waterhouse, jun., and he had been informed by Dr. Percy that the system employed was incomparably superior to any plan hitherto adopted. With regard to the Houses of Parliament, the arrangements of the basement were probably the worst that human ingenuity could devise, for a main sewer ran right through the centre, and this sewer was until a very recent date, and

he believed was still, tide-locked, so that for a certain number of hours every day the contents were imprisoned. This would probably be remedied when the embankment and the low level sewerage works were completed, but there was nothing to prevent the sewer being moved and carried under the esplanade, or at the other side of the building, instead of along the centre of it.

The CHAIRMAN having proposed a vote of thanks to Dr. Edward Smith for his instructive paper, which was unanimously agreed to,

Dr. EDWARD SMITH, in reply to the observations which had been made, said the subject of ventilation was a very wide one, and he ought not to be blamed for not having touched upon matters which did not come within the scope of the particular department which he had allotted himself for the evening, as mentioned in the paper. The ventilation of mines was, of course, a special subject, and could not be treated in the same way as the ventilation of houses or buildings. With regard to churches, one great defect in modern churches was the system of side galleries, the highest parts of which were, perhaps, fifteen feet above the floor, and underneath were sometimes congregated a great number of people, while there was no means of escape for the foul air. He should recommend openings through the galleries, so that the heated air could escape to the upper part of the building, and freely make its exit. The apertures for this purpose should be near the top, and small in size, so as not to cause a draught, while the present system of hoppers might still be retained for the purpose of ventilating the church when empty. One gentleman had complained that no information had been given how to use his doors and windows as means of ventilation. He contended that, inasmuch as windows were required to be closed at night, they must not be depended upon for ventilation, but other means must be provided. The system he recommended in workhouses was to build all the bed rooms with external windows on each side, but they were not dependent on these for ventilation, there being independent apertures for the purpose, defended on the inside by perforated zinc. The ordinary rooms might be built in two parallel rows, with a corridor between, and into that there opened a number of ventilating windows on each side, hung on a centre, and so arranged that they could not be closed. The closets were now all built so as to allow of a cross draught, a window being placed on each side. The same system was in a great measure applicable to ordinary private dwellings, and he could also recommend the suggestions of Mr. Rawlinson. Dr. Stallard objected to cold air being introduced at the top or at the bottom of a room, and he, therefore hoped that on a future occasion he would give them some suggestions of his own as to how it should be supplied, and also the results of his investigations into the action of carbonic acid, which was a most important subject.

The paper was illustrated by models of various systems of ventilation, contributed by Mr. Varley, Mr. T. Twining, Messrs. Hart and Son (who showed M'Haffie's self-acting ventilator), and Mr. Waller. Mr. Twining's model was intended to illustrate a plan proposed by him for establishing a through draught between the front and back of any building (including even those on the internal corridor system) without making the respective inmates dependent on each other. The corridor itself might be ventilated if necessary on the same principle.

### Fine Arts.

SOCIETY OF THE FRIENDS OF ART, LYONS.—This society has just issued its annual report, which not only deals with what has been already done by it in aid of art, but also with the means which remain to be brought into play. The report expresses regret that the

exhibitions of the society do not attract artists of the highest reputation, or pictures of the greatest interest, Paris presenting more material inducements to the artist than the provinces can possibly hold forth. One inducement suggested as capable of producing some effect is that the principal administration should apply a portion of the funds at its disposal in the purchase of modern pictures for its museum; the choice of such acquisitions, says the report, would be more sure, less contestable, than that of ancient works, and would have the effect of completing the collection and keeping it *au courant* with the history of art, by introducing year by year some of the most remarkable works of each period, and thus giving to students, as well as connoisseurs, all the pleasure as well as the practical advantages of comparison of the various styles of art. A museum should be less a depository of ancient art than a living city in which all ages and all kinds of merit are sympathetically united. If such a plan were adopted, it is certain that eminent artists would find it worth while to send their works to such an exhibition as that of Lyons, in the hope of their being purchased for its museum. The income of the society amounted last year to £2,382, and was employed as follows:—Purchase of fifty works of art, £1,110; prizes, £211; annual publication, £138; expenses of carriage, reduced by the railway companies to half the ordinary rates, £134; expenses of the exhibition and printing, £214; salaries and sundries, £224. In addition to this, the society acted as agent in the purchase of works of art for the town and for private amateurs to the extent of £1,020. Putting all the purchases and prizes together, the society was the means of benefiting artists to the extent of about £2,480 during the year—a result which certainly cannot be regarded as unimportant.

### Commerce.

EXPORTS OF SILK FROM MILAN TO GERMANY AND SWITZERLAND.—The exports of silk from Milan to Germany and Switzerland during the year ending 30th September, 1868, show a considerable increase on those of the previous year, and were as follows:—

	From Sept. 30, 1867, to Sept. 30, 1868.	From Sept. 30, 1866 to Sept. 30, 1867.
	No. of Bales.	No. of Bales.
By Splügen pass..	8,281	9,358
By St. Gothard pass	6,207	4,821
Total No. of bales	14,488	14,179

To Vienna, *via* Nabzernia, the number of bales sent from Milan during the year ending 30th September, 1868, was 1,569, weighing 116,728 kils.; whilst that of the previous year amounted to only 987 bales, weighing 73,337 kils.

MOVEMENT OF SHIPPING AT ANTWERP.—During the past year, 1868, 3,547 vessels entered the port of Antwerp, and 3,504 sailed during the same period.

### MEETINGS FOR THE ENSUING WEEK.

MON.....Farmers' Club, 5½. Prof. Voelcker, "On the Adulteration of Feeding Stuffs and Artificial Manures."  
Social Science Assoc., 8. Rev. Brooke Lambert, "On the Position of the National Schoolmaster."  
Royal Inst., 2. General Monthly Meeting.  
Entomological, 7.  
British Architects, 8.  
Medical, 7. Annual Election.  
London Inst., 6.  
Medical and Chirurgical, 8. Annual Meeting.  
TUES...Civil Engineers, 8. 1. Mr. Imrie Bell, "On Sinking Wells for the Foundations of the Piers of the Jumna Bridge, Delhi Railway." 2. Mr. John Milroy, "Description of Apparatus for Excavating the Interior of, and for Sinking Iron Cylinders."  
Pathological, 8.

- Anthropological, 8.  
Syro-Egyptian, 74. Mr. Bonomi, "On the Advancement of Egyptian Discovery."  
Royal Inst., 3. Rev. F. W. Farrar, "On Comparative Philology."  
WED ... Society of Arts, 8. Mr. H. H. Sales, "On the Adaptation and Extension of Present Means for the Promotion of Scientific Instruction."  
Pharmaceutical, 8.  
R. Society of Literature, 44.  
Obstetrical, 8.  
THUR ... Royal, 84.  
Antiquaries, 84.  
Royal Inst., 3. Dr. Harley, "On Respiration."  
Linnean, 8.  
Chemical, 8.  
Royal Society Club, 6.  
London Inst., 6.  
Artists and Amateurs, 8.  
FRI ..... Geologists' Assoc., 8.  
Royal Inst., 8. Mr. W. Huggins, "On some further results of Spectrum Analysis, applied to the Heavenly Bodies."  
Archæological Inst., 4.  
SAT ..... Royal Inst., 3. Prof. Odling, "Hydrogen and its Analogues."

## PARLIAMENTARY REPORTS.

### SESSIONAL PRINTED PAPERS.

- Par.  
Numb.  
*Delivered on 1st January, 1869.*  
SESSION 1868.  
119. (x.) Trade and Navigation Accounts (30th November, 1868).  
433. (ii.) Endowed Charities—General Digest.  
461. (i.) Newspapers—Return.  
*Delivered on 8th January, 1869.*  
2. (i.) Railways Abandonment—Warrant of the Board of Trade.  
2. (ii.) Railways Abandonment—Warrant of the Board of Trade.  
2. (iii.) Railways Abandonment—Warrant of the Board of Trade.  
SESSION 1868.  
436. Local Taxation—Returns.  
473. Iron-plated Ships and Batteries—Returns.  
*Delivered on 12th January, 1869.*  
Agricultural Returns of Great Britain, and Abstract Returns for the United Kingdom, &c., and Foreign Countries.  
*Delivered on 16th January, 1869.*  
SESSION 1868.  
151. (x.) Trade Accounts (Foreign Countries).  
402. (i.) Sale of Liquors on Sunday Bill—Index to the Report.  
*Delivered on 1st February, 1869.*  
SESSION 1868.  
170. (ii.) Navy (Health)—Statistical Abstract.  
232. (ii.) Industrial and Provident Societies—Return.  
478. Poor Law Unions (Valuation Lists)—Return.  
*Delivered on 3rd February, 1869.*  
344. (A VI.) Poor Rates and Pauperism—Return (A).  
*Delivered on 10th February, 1869.*  
Established Church (Ireland)—Appendix to the Report.  
*Delivered on 11th February, 1869.*  
SESSION 1868.  
344. (A VI.) Poor Rates and Pauperism—Return (A), corrected copy.  
392. (i.) Grand Jury Presentments (Ireland)—Index to the Report.  
471. Navy (Transports)—Return.  
*Delivered on 12th February, 1869.*  
SESSION 1868.  
151. (xi.) Trade Accounts (Foreign Countries).  
433. (iii.) Endowed Charities—General Digest.  
*Delivered on 17th February, 1869.*  
Business of the House—Rules, Orders, and Forms of Proceeding of the House of Commons relating to Public Business, 1869.  
Queen's Speech.  
*Delivered on 18th February, 1869.*  
Private Bills—Statement of Proceedings.  
*Delivered on 19th February, 1869.*  
3. Bill—Endowed Schools.  
1. (i.) Parliamentary Elections Act (1868)—Additional General Rules, &c.  
7. Railway and Tramway Bills—Report of the Board of Trade.  
China, No. 1 (1869)—Correspondence.  
China, No. 2 (1869)—Correspondence.  
Manufactures, Commerce, &c.—Reports by Her Majesty's Secretaries of Embassy and Legation, Nos. 5 and 6 (1868).  
Poor Relief (Scotland)—Twenty-third Annual Report.  
Sugar Drawbacks—Additional Papers.  
Mecklenburg-Schwerin—Declaration of Accession to the Treaty of Navigation between Great Britain and Prussia.  
Mecklenburg-Schwerin, Mecklenburg-Strelitz, Lauenburg, and Lubeck—Declaration of Accession to the Treaty of Commerce of May, 1865, between Great Britain and the Zollverein.

## Patents.

From Commissioners of Patents' Journal, February 19.

### GRANTS OF PROVISIONAL PROTECTION.

Artificial teeth—317—A. E. Harris.  
Buildings, &c., warming and heating—3282—A. H. Smith.  
Casks—414—C. T. E. Lascelles.  
Chimneys, guards for—366—W. Blundell.  
Clyster-pumps—382—E. J. D. Fossard.  
Corsets—332—C. E. Brooman.  
Cotton, &c., paste for fixing and brightening aniline and pigment colours in printing on—420—J. Clayton.  
Cotton, &c., twisting yarns and other threads of—310—R. Caunce and M. G. and B. Bradley.  
Electric light, producing—390—F. Jenkin.  
Explosive projectiles—354—J. Jobson.  
Feeding bottles—392—R., G., and C. W. Phelps.  
Filters—416—J. F. Bentley.  
Furnaces, &c.—422—J. A. F. Suter and T. C. Hinde.  
Guns or ordnance, working—348—J. Vavasseur.  
Hats, &c.—412—W. Lever.  
Jacquards, &c.—378—B. Walker and W. Tilson.  
Jelly broth, compound for preparing—374—H. A. Bonneville.  
Lamps—428—G. A. Nowell.  
Lifting apparatus—360—J. Taylor.  
Looms—396—J. Wilkinson and W. Scott.  
Looms—408—W. Hilton.  
Meters for measuring water—432—B. P. Stockman.  
Mixed fibres, separating animal from vegetable fibres in materials composed of—410—J. Stuart.  
Organs—340—H. and J. Bryceson and T. H. Morten.  
Paper, manufacturing—404—J. H. Johnson.  
Paraffine oil—376—E. Meldrum.  
Puddling furnaces—362—J. Halford.  
Puddling furnaces, &c.—370—W. R. Lake.  
Puddling furnaces, &c.—366—W. R. Lake.  
Railway trains, communication in—292—T. Pimbley.  
Railway trains, communication in—394—W. Williams.  
Railway trains, communication in—406—K. B. Edwards.  
Railway trains, communication in—424—J. E. Billups, W. Cooper, G. T. A. Hine, and W. Young.  
Rosettes and trimmings—366—C. G. Hill.  
Semolina and flour, machinery for manufacturing—342—J. J. Bagshawe and W. F. Batho.  
Ships, &c., propelling—346—P. Jensen.  
Slip hooks—350—G. Bray.  
Steam engines, governors for—384—J. H. Johnson.  
Stearine—364—A. Browne.  
Steel and iron—426—G. F. Ansell.  
Stoves—439—H. P. Hansen.  
Surface condensers and refrigerators—358—J. Henderson.  
Vacuum gauges, &c.—388—B. Hunt.  
Water and drain pipes—3158—A. Robins.

### PATENTS SEALED.

2508. J. McFarlane.	2709. E. Cortazzi.
2596. H. N. Waters.	2727. T. Butterworth.
2599. H. Hughes.	2729. A. M. A. Laforgue.
2604. E. J. E. Niepce, jun.	2784. A. A. Lejeune.
2608. T. W. Rammell.	2789. A. B. Ibbotson.
2613. T. Wrigley and J. Holding.	3167. R. Pearce.
2617. J. Watson.	3535. A. V. Newton.
2646. R. Harvey.	3881. H. G. Thompson.
2684. W. S. Fletcher.	3923. H. G. Thompson.
2702. T. G. F. Dolby.	3976. H. A. Bonneville.

From Commissioners of Patents' Journal, February 23.

### PATENTS SEALED.

2632. G. S. Dracopulo.	2718. F. Preston and R. C. Ross.
2634. J. Jeavons and C. Martin.	2721. A. M. Clark.
2636. R. Scholefield.	2742. W. H. Crispin.
2657. J. Hanson.	2831. M. Benson.
2664. B. Burrows, sen.	2998. J. H. Johnson.
2665. N. J. Holmes.	3181. W. T. Rickard and W. C. Paul.
2667. W. Strang.	3720. A. Krupp.
2673. C. H. Gardner.	16. J. G. Tongue.
2689. H. Walker.	
2695. L. F. A. P. Riviere.	

### PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

478. J. Young.	521. A. Moore.
513. J. Kidd.	539. H. S. Swift.
498. E. J. C. Welch.	592. W. Clark.
520. T. Kennedy.	574. T. Bulley.

### PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

448. J. Wilcox.	459. J. Spence.
425. J. Combe.	492. T. N. Kirkham and V. F. Ensom.
506. T. Watson and R. Dracup.	
1248. J. E. A. Gwynne.	482. R. Foster, jun.